AAPG EXPLORER
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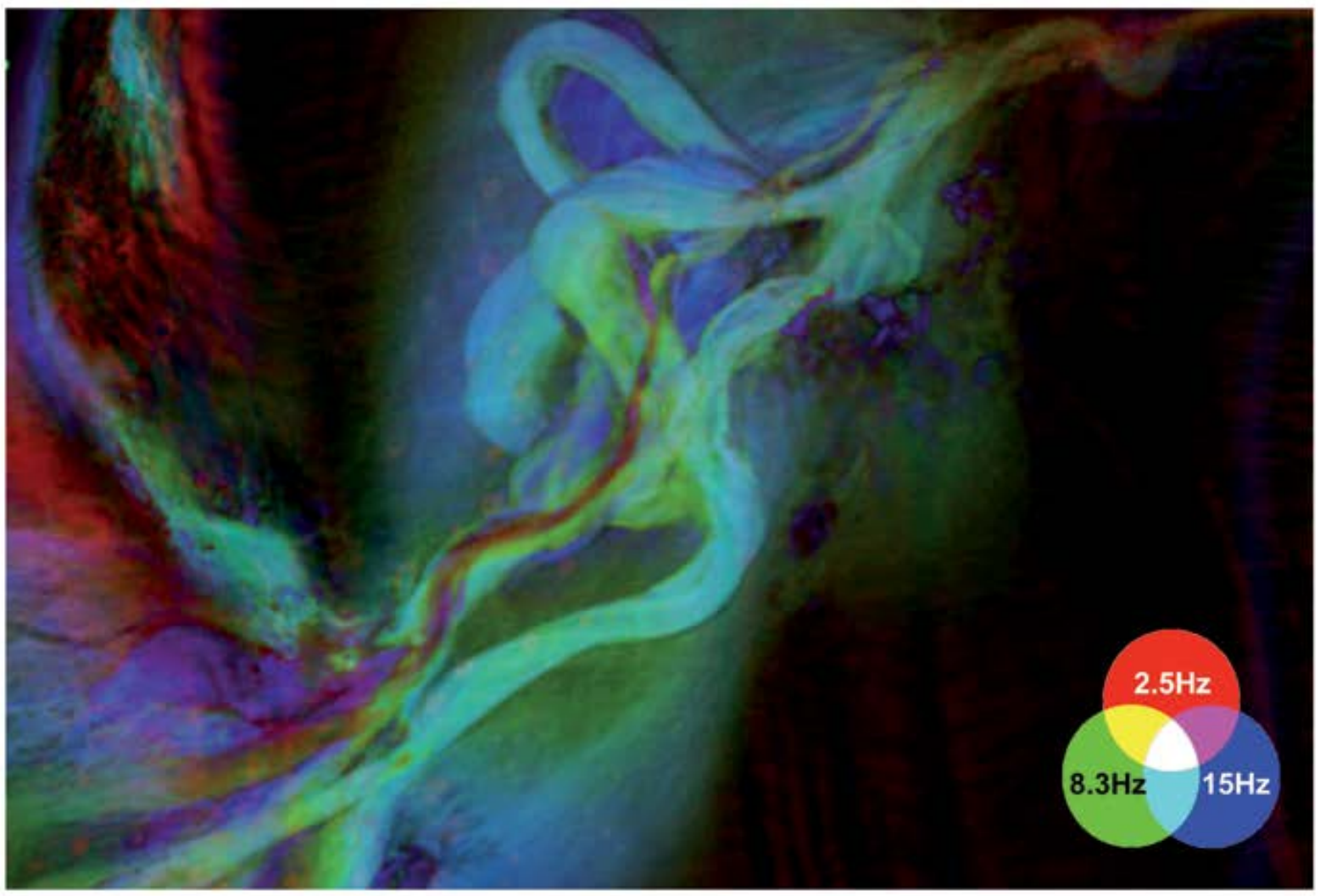

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Passion for Geoscience

Vol. 35, No. 5
May 2014

AAPG EXPLORER

PRESIDENT'S COLUMN

Do We Burst Bubbles, or Will We Bust the Ceiling?

BY LEE F. KRYSTINIK

Some of my friends might say I live in a bubble – and in this particular case, my bubble includes a number of exceptional and dedicated female colleagues with whom I have the pleasure of routinely interacting in business, through the AAPG Executive Committee and throughout the leadership of AAPG.

These women comprise about 40 percent of the high-impact people in my bubble.

The actual numbers at AAPG show that women make up 25 percent of the EC, 15 percent of our EC candidates and 17 percent of the Advisory Council.

By contrast, women make up 40 percent of the global workforce and, depending upon age bracket, are 25-40 percent of the geoscience side of our industry.

AAPG is working to include our female colleagues in many levels of leadership within our organization, but there is still a lot left to do.

* * *

So, if AAPG is working toward doing what we say we do, how are we doing as an industry full of AAPG members?

While attending a recent "Exploration Managers" luncheon (something like it probably occurs regularly in your local oil and gas community), I found myself surrounded by a group of about a hundred men and one woman. This rather abruptly popped my bubble and reminded me that there is a larger reality than my little 40-60 world!

Yes, folks, that's approximately one percent (1 percent)!

Now, at the entry level, I have heard it said that the median geoscientist coming into the industry is a young woman, likely from somewhere around the globe other than the United States. This is what I have observed in my travels throughout North America and our Regions. Women often make up more than 50 percent of the students and young professionals I have had the pleasure of meeting.


KRYSTINIK

The question: Are we facilitating a path to success for all of our employees, or are we (either directly or indirectly) inhibiting their path?

This would seem to speak very well indeed for our future – but does it?

How is it that we find ourselves with only a few percent of top management positions occupied by females in our industry, even though women geoscientists have been involved in our industry since before the inception of AAPG nearly 100 years ago?

The question we have to ask within our industry is whether we are facilitating a path to success for all of our employees, or whether we are (either directly or indirectly) inhibiting their path.

In visiting with other middle-aged males (Yup, I am in that age group, too) some offer comments like:

"Unfortunately the biological imperative is that if they want a family, women bear the brunt of having and caring for their children, which takes them out of the workplace at a critical time in their careers."

In fact, some women do choose to leave the workplace for their families and themselves. Others, however, may decide to remain in the workplace while raising a family. And still others may opt to go "all in" with our industry.

Having navigated that decision, the women I have worked with throughout my career have handled almost any industry management challenge quite well indeed.

But, after making those tough choices, are the women who remain in the workplace fairly represented at the top?

Short answer: NO.

* * *

So what are we doing about it in our industry?

By "we" I mean us experienced guys who have it within our capability to invite our female colleagues to Exploration Manager luncheons and other professional gatherings, where they can build their contacts and grow professionally – in other words, provide them the same opportunities we were given when we were younger, by bosses who thought we might grow up to be just like them some day.

Are subtle biases causing us to slot women into roles that create "glass walls," and keep them from getting the diversity of experience they need to ever be managers?

Are we cloning our potential successors to look like younger versions of us?

Or are we strategically selecting people with different ways of thinking needed to find new oil and gas, regardless of gender, ethnicity, whatever?

Taking down the glass walls ultimately will drop the proverbial "glass ceiling," and providing the freedom to grow laterally within a company and learn our business is critical to this process.

And, as AAPG members, are we encouraging and nominating our female colleagues to stand as delegates, councilors or officers on behalf of AAPG?

Are we nominating them for AAPG awards?

Are we making room for them by stepping aside, having already had our long turn at the table, and are we then lobbying and voting for them?

These are simple, specific things we can and should do that will make a real difference!

It would seem that it is well past time to share the boardroom equitably with the other half of our population.

This will not happen without our intentional, deliberate choices and actions.

* * *

Maybe we can all work together to replace my popped bubble with a reality that reflects the ideals of fairness that underpin AAPG – so, if you have any ideas on how AAPG can be more inclusive, or how we can better do what we say we will do, please feel free to contact me at LeeKrystinik@AAPG.org.

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REGULAR DEPARTMENTS

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Photo courtesy of Shell

ON THE COVER:

This month the EXPLORER offers a new editorial theme, "Offshore Developments," with several stories dealing with offshore activities around the world – and some that specifically reference the upcoming Offshore Technology Conference in Houston. The cover photo represents that theme – the Britannia Satellites in the North Sea, about 130 miles northeast of Aberdeen, Scotland. Photo courtesy ConocoPhillips.

Left: Shell's Olympus platform on the Mars Field in the Gulf of Mexico.

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Voting Deadline Arrives May 15

Voting continues in the election of new officers for the AAPG 2014-15 Executive Committee, but the voting deadline arrives this month.

Voting will remain open through May 15.

Members have the option of casting a ballot either online or via mail.

To assist in the voting process, biographical information on all six AAPG officer candidates for the 2014-15 Executive Committee is available online, as is their responses on the topic: "Why I Accepted the Invitation to be a Candidate for an AAPG Office."

Also available online are videos of all six candidates – featuring a conversational question-answer format – showing the candidates as they respond to six specific questions.

The videos are intended to allow members around the world to have a better introduction to those running for office.

The person voted president-elect will serve in that capacity for one year and will be AAPG president for 2015-16. The terms for vice president-Sections and treasurer are two years.

To view the videos, go online to www.aapg.org/business/candidates/.

The slate is:

President-Elect

❒ **Alfredo E. Guzmán**, consultant, Veracruz, Mexico.

❒ **John R. Hogg**, MGM Energy Corp., Calgary, Canada.

Vice President-Sections

❒ **Steven H. Brachman**, Wapiti Energy, Houston.

❒ **Hannes E. Leetaru**, Illinois State Geological Survey, Urbana, Ill.

Treasurer

❒ **Vlastimila Dvorakova**, Czech Geological Survey, Brno, Czech Republic.

❒ **James W. Tucker**, consultant, Houston.

HoD Votes: One Sponsor Required

By BRIAN ERVIN,
EXPLORER Assistant Managing Editor

Full membership in AAPG will now require only one sponsor, following a lengthy and impassioned debate among the members of the AAPG House of Delegates at the group's annual meeting before the Annual Convention and Exhibition in Houston.

The body approved an amendment to the AAPG Bylaws that will lower the current requirement of three sponsors.

The amendment was a compromise and substitute for another proposed amendment that would have removed the sponsorship requirement entirely.

Proponents of the initially proposed amendment, like AAPG Secretary Richard Ball, argued that the sponsorship requirement has been an unnecessary barrier to membership that has discouraged in particular young professionals, internationals and geologists outside major energy hubs from upgrading from associate to full membership with voting rights.

"Richard Ball's slide on our membership trends is a huge red flag for our organization," said Jeff Lund of the Houston Geological Association, who argued to drop the sponsorship requirement.

Ball and others contended that the sponsorship requirement is unnecessary to maintaining AAPG's ethical standards because "nefarious people can find three sponsors"; potential members should be considered innocent of being unethical until proven guilty; and if members are admitted and then make ethical breaches, expulsion is still an option – something that has only happened seven times in the last 30 years, Ball pointed out.

AAPG treasurer and past DPA president Deborah Sacrey, however, rebutted that there have been so few ethical breaches within AAPG's ranks precisely because the sponsorship requirement screens potential members.

She and other opponents to the proposed change argued that eliminating the peer-review aspect would devalue AAPG membership, thereby relegating the Association to resemble a mere trade organization.

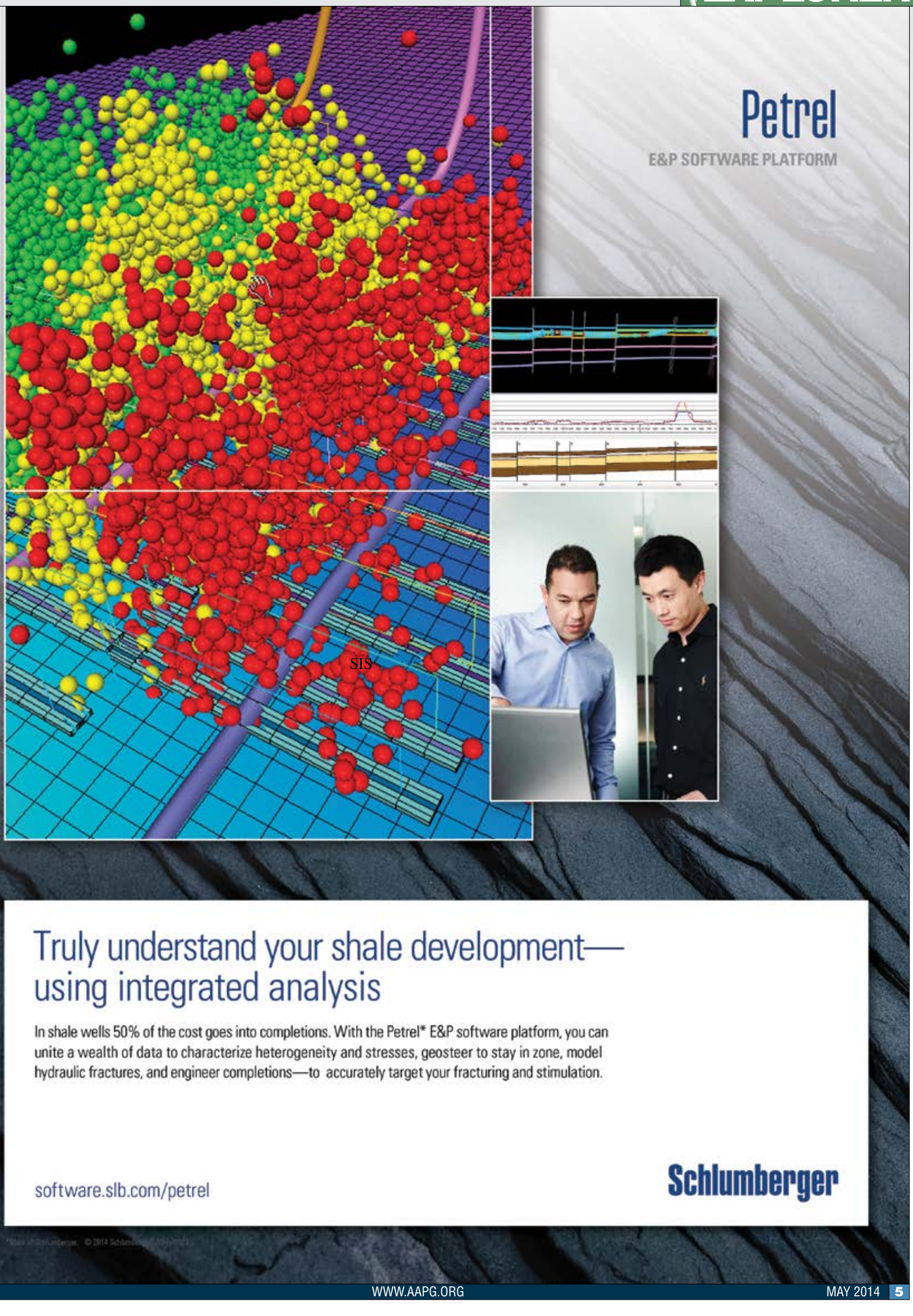
Also, while proponents cited the consensus among AAPG's leadership councils and committees, delegates who opposed the change argued that the consensus among members appears to favor keeping the sponsorship requirement.

Of the 207 HoD members in attendance, 116 voted to approve the substitute amendment to lower the sponsorship requirement to one, with 76 who voted against it.

After the approval of the new amendment, 158 voted to enact it, with 34 against.

Some delegates argued that the substitute amendment is a good compromise: one sponsor should be easy to find, and if the lowered requirement proves detrimental, it can always be changed next year, while a full removal of the sponsorship requirement might not be so easy to reverse.

"The genie's not completely out of the bottle if we lower it to one," said another delegate.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Resurgence amidst shale boom

GoM Update: Old Dogs Still Going Strong

By LOUISE S. DURHAM, EXPLORER Correspondent

America's recent ascent to the high-level status of a hydrocarbon producer worthy of a significant presence on the world stage of leading producers stems from something new and a rebirth of something old.

The new is the still-increasing number of shale oil and shale gas plays that have been quite the industry game changer in and of themselves.

The old is aptly exemplified by a couple of long-familiar regions: the Gulf of Mexico and the Permian Basin.

These old dogs still hunt.

The once-again renewed activity in the long-producing Permian Basin, is targeting not just new shale plays but conventional sources using new technology. Even so, successful vertical drilling is on par with laterals.

The historic high profile Gulf of Mexico, like the Permian, has experienced more than one life since the first offshore well was drilled in 1938.

As recently as the late 20th century it was derided as the "dead sea," a moniker incurred by the lack of E&P owing to what was perceived to be a dwindling resource base particularly in the readily accessible shallow water region.

Following this somewhat lengthy quiescent period, activity revved up impressively.

The deep offshore waters and even deeper subsurface hydrocarbon-bearing zones became economical to tap into as technology advances for seismic drilling completion and more made a lot of activity possible and economical such as deeper drilling and completions.

Photo courtesy of Shell

Shell's Olympus platform (foreground) and Mars platform (background) in the Gulf of Mexico.

Then the virtual lightening bolt, aka the Macondo blowout, hit in 2010, and essentially everything in the Gulf that was industry-related came to a screeching halt owing to the ensuing moratorium dictated by the U.S. government.

Ironically, this led in part to the current resurgence in the Permian. Many operators had to put their GoM budgets to work somewhere, and the Permian was just waiting for more drill bits to go down to dip into its significant reserves.

The Resurgence

Today, GoM activity is back in full swing, albeit with numerous new regulatory guidelines and restrictions in place.

Operators are eagerly chasing the estimated 48 billion barrels of oil yet to be discovered, according to the U.S. Department of the Interior.

Industry research company Wood Mackenzie reportedly is estimating deepwater output equivalent of almost two million bopd in 2020.

Even for die-hard industry workers, this is particularly amazing when one considers how challenging, risky and expensive the deepwater environment is for operators.

Veteran deepwater Gulf operator Shell announced yet another successful exploratory Vicksburg well in 2013, 75 miles offshore in the DeSoto Canyon Block 393 in 7,446 feet of water. It reached TD of 26,385 feet.

The Jurassic-age Vicksburg "A" discovery is estimated to hold potentially recoverable resources of more than 100 MMboe, according to AAPG member Mark Shuster, executive vice president of exploration for Shell Upstream Americas.

This is a significant addition to the 500 MMboe of potentially recoverable resources already discovered and appraised at the nearby Appomattox and Vicksburg "B" discoveries.

Like its peers, the company is hard at work in varied GoM locales. It recently announced the start of production from the deepwater Mars B field development program via Olympus, which is the largest floating, deepwater platform in the Gulf.

Combined future production from Olympus and the original Mars platform is expected to deliver an estimated resource base of one Bboe, according to Shell.

There is considerable excitement over the Stones project Shell is developing. The field is in the Walker Ridge area about 200 miles offshore Louisiana in water approximately 9,500 feet deep.

It will include the use of Shell's first FPSO in the Gulf, which is said to be the deepest-water FPSO unit worldwide.

New AAPG Wiki Site Launched

AAPG has launched its new Wiki site, which can be found at wiki.aapg.org.

It is intended to be a resource of geologic knowledge for students of all ages, teachers, practicing geoscientists and the public at large.

Created to engage a broad cross-section of geoscience experts and augment its traditional publishing, AAPG's new wiki currently has more than 700 articles, pulled from two AAPG books: "Methods in Exploration #10: Development Geology Reference Manual," and "Treatise in Petroleum Geology #3: Exploring for Oil & Gas Traps."

The wiki is free, and anyone can sign up to help edit or create articles.

Wiki specialist Cecilia Whitehurst monitors the site, reviewing new pages and coordinating edits. AAPG also has set up an Advisory Board to review the accuracy of new articles.

"AAPG's new wiki harnesses the power of emerging publishing technology to deliver AAPG science in to the hands of members, customers and the public," said Executive Director David Curtiss. "The wiki is intended to augment our peer-reviewed publications program – and we hope that it engages an entire new generation of geoscientists to share their knowledge and expertise with a broad audience."

The project was initiated with financial support provided by Apache Corporation.

AAPG members are encouraged to visit the wiki and add or edit articles – email wiki@aapg.org for feedback or more information.

Intense interest

GoM Lease Sale Nets $872 Million

By LOUISE S. DURHAM, EXPLORER Correspondent

The current intense interest in the Gulf was underscored during the lease sales in March 2014 in the Central and Eastern areas.

Sales for federal waters captured more than $872 million in high bids on 329 tracts spread over close to 1,707,358 acres, according to Sally Jewell, Secretary of the Department of the Interior.

The Central Planning Area lease sale 231 lured 50 offshore energy firms that submitted 380 bids. In the end, high bids on 326 blocks tallied close to $851 million.

The 326-block area encompassed more than 1.7 million acres on the U.S. OCS offshore Louisiana, Mississippi and Alabama.

Eastern Planning Area lease sale 225 entailed 134 whole or partly unleased blocks spanning about 465,200 acres, located approximately 125 miles south of eastern Alabama and western Florida in water depths as much as 10,000-plus feet.

No bids were submitted, but interest is thought to remain high in this area given the ongoing and planned action on current leases incurred during past sales and on the leases adjacent to the Central Planning Area.

Under the existing Five-Year Offshore Oil and Gas Leasing Program, this area will again be offered to the industry in 2016.

Following the March lease sale, Tommy Beaudreau, director of the Bureau of Ocean Energy Management (BOEM) at the Department of the Interior, is on record as saying: "While domestic energy production is growing rapidly in the United States, the Central Gulf of Mexico, as demonstrated by today's lease sale, will continue to be one of the cornerstones of the nation's energy portfolio."

Offshore lease sales have raised more than $17.3 billion over the last 10 years – and allowed industry to create more jobs and produce more energy.

Priming the Pump

The BOEM set the terms of the sale, which include standards to protect the environment.

Good news tends to help kick-start events just waiting to happen.

Successful lease sales in the Gulf serve to increase the conversation about opening up the off-limits Atlantic and certain parts of the eastern Gulf to hydrocarbon development.

According to API director of Upstream and Industry Operations Erik Milito, each lease sale in the United States increases the country's position as an energy superpower.

"Offshore lease sales have raised more than $17.3 billion for the government over the last 10 years and allowed our industry to create more jobs and produce more energy here at home," Milito said.

"Holding lease sales in the Atlantic and more of the eastern Gulf of Mexico would make America stronger economically and diplomatically," he emphasized.

Core Lab Joint Industry Projects

WEST AFRICA

NEW! CENTRAL ATLANTIC MARGINS – WEST AFRICA: PHASE I
CÔTE D'IVOIRE: REGIONAL RESERVOIRS AND SEALS
NAMIBIA AND THE ORANGE BASIN RESERVOIRS AND SEALS
GABON / NORTH CONGO PRE AND POST-SALT RESERVOIRS
PRE-SALT CLASTIC SOUTH ATLANTIC MARGIN: PHASE I
PRE-SALT CARBONATES SOUTH ATLANTIC MARGIN: PHASE III
POST SALT RESERVOIRS AND SEALS - SOUTH ATLANTIC MARGIN

SOUTH AMERICA

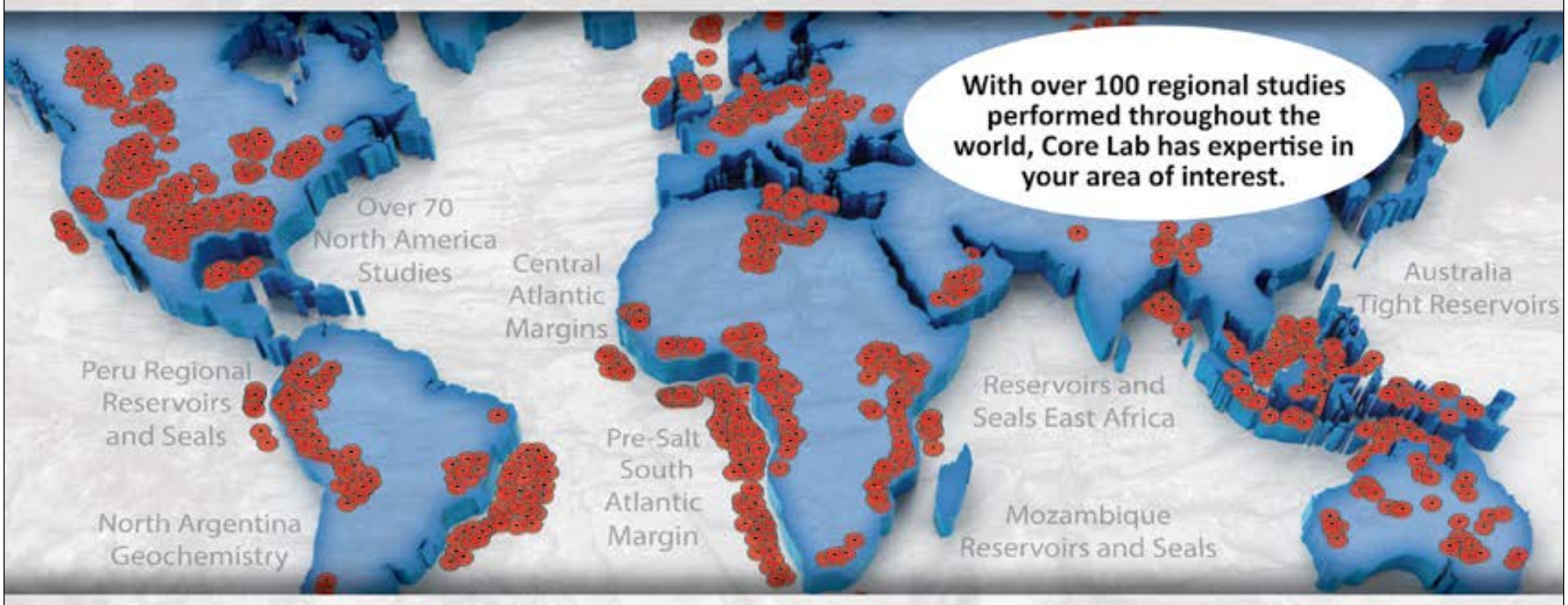
NEW! BRAZIL EQUATORIAL BASINS - RESERVOIRS AND SEALS
NEW! PERU - REGIONAL RESERVOIRS AND SEALS
PRE-SALT SOUTH ATLANTIC MARGIN: PHASE II
BRAZIL - CENTRAL OFFSHORE BASINS PETROLEUM GEOLOGY
BRAZIL - SANTOS BASIN / DEEPWATER PETROLEUM GEOLOGY
BRAZIL - DEEP WATER CAMPOS BASIN
BRAZIL - CRETACEOUS CARBONATES OF SOUTH EAST MARGINS
NORTH ARGENTINA - GEOCHEMISTRY

EAST AFRICA

NEW! MOZAMBIQUE - RESERVOIRS AND SEALS: PHASE IV
TANZANIA RESERVOIRS AND SEALS: PHASE I
KENYA - RESERVOIRS AND SEALS, PHASE II
UGANDA - RESERVOIRS AND SEALS: PHASE III

ASIA/PACIFIC

NEW! AUSTRALIA - TIGHT RESERVOIRS
NEW! INDONESIA - TIGHT RESERVOIRS
VIETNAM RESERVOIRS AND SEALS
DEEPWATER RESERVOIRS - INDONESIA
EAST INDONESIA - FORELAND BASINS
INDONESIA - TARAKAN BASIN
TIMOR GAP / BONAPARTE BASIN
GULF OF THAILAND AND THE OCA
IRIAN JAYA / PNG
INDONESIA - EAST NATUNA



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Rockhopper hits it big offshore Falklands

Mom and Pop E&P Makes Unlikely Success

By HEATHER SAUCIER, EXPLORER Correspondent

Does size really matter?

When it comes to making one of the largest oil discoveries in the last five years, some argue that it most certainly does.

And with all due respect to the world's major energy companies, those at Rockhopper Exploration, a United Kingdom-based company of no more than 25 people, credit their small size as a primary means for finding approximately 400 million barrels of oil in an area of the world that has nearly been forgotten.

Named after a species of penguin near the sub-Antarctic, Rockhopper is quickly establishing itself as an exploration company that is literally hopping from rock to rock near the Falkland Islands, an archipelago adjacent to the southern tip of Argentina, and coming up with multiple finds in the Sea Lion Field in the offshore North Falklands Basin.

The Falklands are a self-governed, British Overseas Dependent Territory.

Chief operating officer and AAPG member Fiona MacAulay described Rockhopper's 2010 discovery as a jigsaw puzzle at the Discovery Thinking forum at AAPG's recent Annual Convention and Exhibition in Houston.

While key pieces of the puzzle included vision, fundraising abilities and technical expertise, a combination of Rockhopper's size and the kind of luck that all explorers need may have trumped all.

"You just need a very different skill set in a small company than perhaps you do in a big company," she said. "Everyone's got to be able to do everything."

"Being small, nimble and committed can reap rewards when you raise capital at critical option points," added AAPG Honorary member Charles A. Sternbach, president of Star Creek Energy Company and founder and co-chair of the Discovery Thinking forum.

"This enables strategic leveraging of value and assets."

MacAULAY

> **"You just need a very different skill set in a small company than perhaps you do in a big company. Everyone's got to be able to do everything."**

Photos courtesy of Rockhopper

After making its first discovery in the Sea Lion Field in the North Falklands Basin, Rockhopper conducts flaring operations to test a well.

A Good Story Gets Better

MacAulay joined Rockhopper in 2010 as its fifth full-time employee with 25 years of experience as a geologist for Mobil, Amerada Hess and BG Group.

"It sounded like a good story," she said of the company's brief but gripping history.

The story was one of chance encounters, MacAulay said, recalling the day that Rockhopper chief executive officer Sam Moody talked to her about the birth of the company. Richard Visick, a British entrepreneur who also engaged in sheep farming on the two islands he owned in the Falklands, needed to apply for a license to transport his sheep.

As he filled out the paperwork for livestock movements, the director of the Falklands' Department of Agriculture, who also oversaw the Department of Mineral Resources, offhandedly mentioned that a batch of offshore oil exploration licenses – formerly held by large energy companies such as Shell and Hess Corporation – were available through open door licensing.

"Have you ever thought about setting up an oil company?" she asked.

Later, Visick contacted Moody, whom he worked with on other ventures, and posed the same question.

They thought, "That sounds like a great idea. How hard can it be?" MacAulay said.

Geological thought processes in the 1970s suggested that oil accumulations were likely in the Falkland Islands area based on speculative data from an old swath of 2-D seismic.

However, when the 1982 Falklands War erupted between the United Kingdom and Argentina, exploration of the area came to a halt. The two countries didn't make amends until the early 1990s. At that time, legal limits of the Argentine continental shelf were established by Argentina and the Falkland Islands, and exploration licenses were issued.

Under a unified agreement, four operators, including Shell, drilled six exploration wells in 1998. All but one revealed promising oil and gas shows, although none penetrated significant reservoirs.

It was ultimately determined that a Lower Cretaceous shale section was a "world class" source rock and highly oil prone, MacAulay said.

But when oil prices plummeted to $10 a barrel shortly after, the players packed their bags and went home to most likely seek cheaper and lower risk opportunities elsewhere.

'Put Up or Shut Up'

All remained quiet on the exploration front until Visick needed to move his sheep.

Having decided to apply for exploration licenses, he hired a consultant and began to study the existing seismic data, findings from the 1998 drilling campaign and from several Deep Sea Drilling Project wells from the 1970s.

After putting the data together, Visick and Moody – having to answer to no one – decided to take a chance. They established Rockhopper in 2004, put together a compelling story of potential and began a fundraising campaign, initially knocking on the doors of friends and family.

"How in the world are they going to drill a well when they've never drilled a well in their life?" MacAulay said, echoing the thoughts of many whom Rockhopper visited to gain financial support.

Their positive vibes, however, proved infectious. They raised $2.5 million for two licenses covering two exploration blocks in the southern part of the North Falklands Basin and for additional 2-D seismic.

To boost their credibility, they hired Pierre Jungels, the former CEO of Enterprise Oil and former board member of Petrofina. Jungels accepted the position of executive chairman of the board at Rockhopper for two main reasons:

- He was intrigued by the findings of an exploration well drilled by Shell in the North Falklands Basin in 1998.
- The price of oil was on the rise.

Rockhopper went public in 2005, raising $24.9 million in an initial public offering with a $50 million market capitalization on the London Stock Exchange.

See **Falklands**, page 12

Rockhopper's support vessels, moored in the Falkland Islands' Stanley Harbor.

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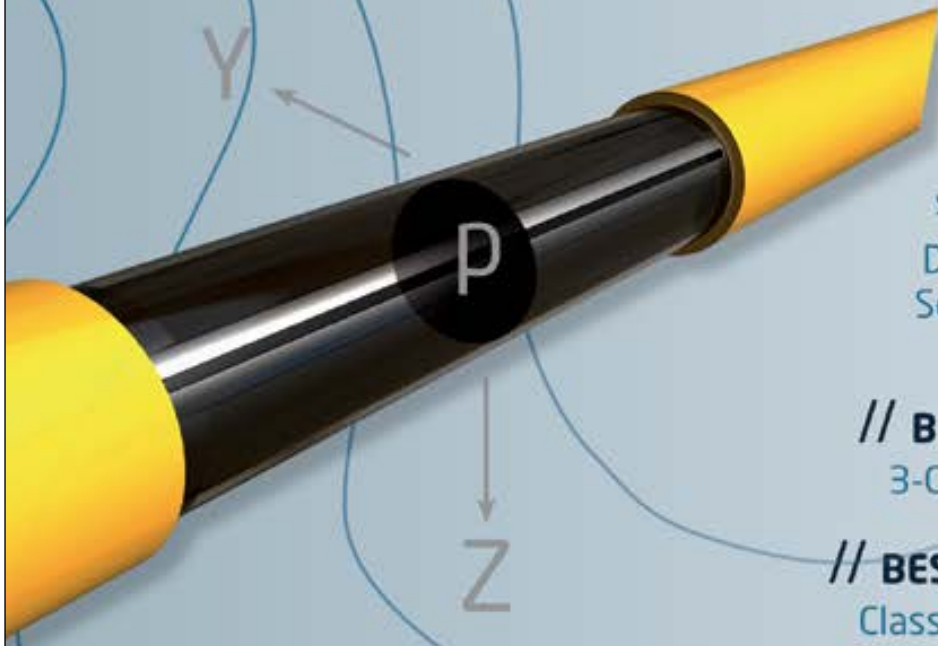

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In pursuit of its first discovery in the North Falklands Basin, Rockhopper deploys helicopters out of Stanley, the Falkland Islands' capital city.

Falklands

from page 10

The company farmed into acreage owned by Desire Petroleum where existing 3-D seismic data was available, identifying fan plays with multiple reservoir sources. They purchased licenses for additional exploration blocks formerly held by Shell and began raising $16 million for the 3-D seismic needed for defining a new play in the nascent basin, which is 124 miles long and 37 miles wide, MacAulay said.

Although inclement weather cut the 3-D seismic acquisition short, enough data was produced to suggest a hydrocarbon-rich reservoir was present.

While they didn't know it at the time, the seismic ran right through the center of the Sea Lion Field. Money was raised to interpret the data and perform the necessary rock physics.

As it turned out, the Sea Lion Field was the highest rated of the mapped prospects and carried a best estimate of 568 million barrels of oil in place with a chance of success of 23 percent, MacAulay said.

Rockhopper wanted to farm out acreage to other operators through the drilling process. Although some expressed interest, no operator came forward.

"It was either put up or shut up and time to roll the dice," MacAulay said. Desire had just signed a rig contract with Diamond Offshore Drilling for three exploration wells. If Rockhopper wanted to join, it was now or never.

After "a hard couple of weeks of begging" for funds from shareholders, and with just $1 million left in the bank, Rockhopper met its financial goals.

How Lucky Can You Get?

The Sea Lion Well, the first well drilled in April 2010, delivered a discovery: more than 164 feet of net pay.

"How hard can this be?" asked the Rockhopper novices.

Flying by the seat of its pants, the virtually unknown company quickly realized it needed to hire an expert in well operations, field appraisal and development. MacAulay stepped up to the plate.

She directed the team to test the well to ensure oil could be flowed to the surface and conduct the necessary appraisals. The company's stock was quickly rising, making its fundraising campaign practically a piece of cake.

Flowing oil? Check.

Next on the list was raising $45 million to keep the rig longer. At this point, only half of the Sea Lion Field could be seen, and a complete picture was needed. Additional staff members and contractors were hired and remained on call 24/7 for 397 days.

"It's amazing how 75 percent of the decisions that need to be made happen at night," MacAulay said. They oversaw the drilling of nine additional wells and the simultaneous running two 3-D seismic vessels.

Rockhopper had 28 days prior to spud to submit each of the well permits based on the imaging being cranked out from the boats and made it "by the skin of our teeth," she said. Because the areas where they wanted to drill abutted neighboring licenses, Rockhopper brokered a deal to drill in acreage owned

See **Team Effort**, page 14

Team Effort

from page 12

by Desire, taking operatorship of the area that they most wanted.

Although drilling the next two wells was "nail biting," they proved to be successful.

Emotions at Rockhopper ran wild until someone remembered the company still needed to submit the required well permits – and time was of the essence.

"It is during this time that we realized how lucky we were to be small and able to make decisions entirely within our power and at great speed," MacAulay said.

A Small World After All

The company skipped the lengthy process of drilling and coring and instead drilled from spud to total depth in 12 days – a testament to how adept its drill team had become.

To develop its discovery, Rockhopper began approaching operators once more. This time, they listened. In 2012, two companies battled it out, and in the end, in a "cash-and-carry" trade, Rockhopper farmed out 60 percent of its licenses to Premier Oil, which now holds formal operatorship of the acreage.

"Discovering, appraising and farming out Sea Lion has given a solid foundation for what we firmly believe can become a strong international exploration and production company," Moody said. "Rockhopper is and always has been a team effort, and I am proud to have been a part of that team along with Fiona, Pierre, Richard, our board and everyone who works here."

Rockhopper conducts flare tests on a well in the Sea Lion Field in the North Falklands Basin.

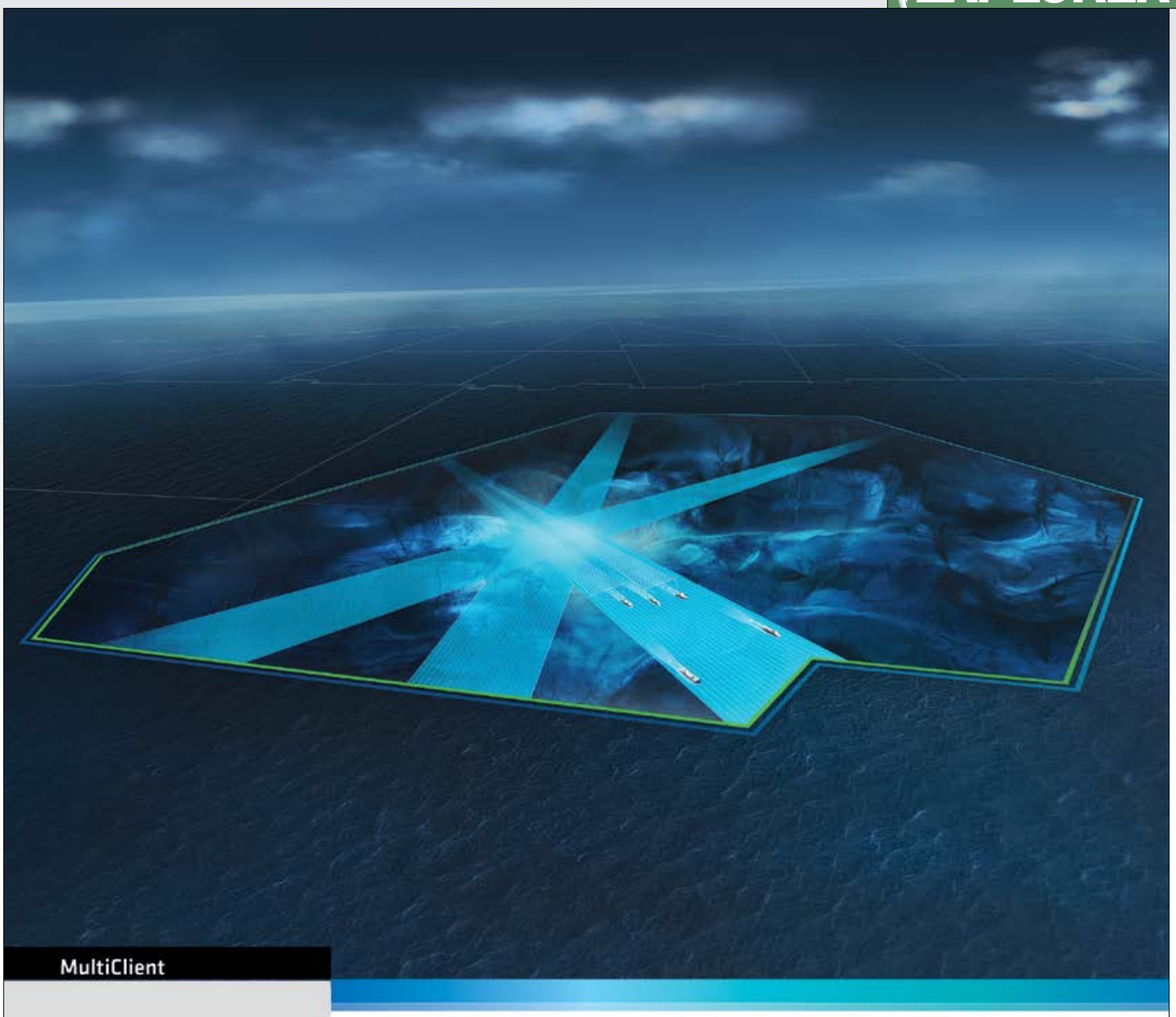
To date, Rockhopper has cut a total of 1,804 feet of core through each of its reservoirs, run comprehensive logs on all 10 wells, and has analyzed samples for biostratigraphy, chemostratigraphy and geochemistry, MacAulay said.

By the end of this 10-year work program, Rockhopper has amassed 317 square miles of exploration licenses, 1.3 billion barrels of oil in the ground and 400 million barrels of recoverable resources.

Currently, the tiny oil company is envisioning a state-of-the-art tension leg platform for development that is slightly larger than Shell's Mars B in the Gulf of Mexico. It is spending $3.8 billion to recover its first oil that it found for roughly $1 per barrel.

Rockhopper also is in the process of planning its next exploration campaign in the North Falklands Basin to potentially double the existing resource base.

"We are proud that we were able to do something so special in a professional and safe manner," MacAulay said. "Small is beautiful."



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Registration Opens for URTeC

The technical program is now in place and registrations are being accepted for the second annual Unconventional Resources Technology (URTeC) Conference, which will be held Aug. 25-27 at the Colorado Convention Center in Denver.

URTeC, hosted jointly by AAPG, the Society of Petroleum Engineers (SPE) and the Society of Exploration Geophysicists (SEG), is the industry's only integrated event for unconventional resource teams.

"It's the only conference where the three big professional societies come together," said AAPG Honorary member Randy Ray of R3 Exploration Corp., who also co-chairs the URTeC technical program committee as a representative of SEG.

His co-chairs are Honorary member and past AAPG president Steve Sonnenberg and AAPG Associate member Luis Baez.

The technical program boasts papers from all three disciplines.

The event will open with a plenary session to explore the technologies and practices needed for success in the unconventionals arena.

Panelists will include Robert Ryan, vice president-Global Development, Chevron; Brad Holly, vice president–Rockies, Anadarko Petroleum; Scott Key, chief executive officer, IHS; Jay Ottoson, president and chief operating officer, SM Energy; and Tom Petrie, president, Petrie Partners.

For more information go to the URTeC website, at www.urtec.org.

Offshore Technology Conference Set May 5-8

AAPG once again will have a strong presence at the annual Offshore Technology Conference (OTC), which will be held May 5-8 at the Reliant Center in Houston.

OTC, sponsored in part by AAPG, is regarded to be the world's premiere event for the development of offshore resources in the areas of exploration, drilling, production and environmental protection.

OTC this year will be celebrating its 45th anniversary.

A large part of OTC's appeal can be found in its enormous exhibits area, where more than 2,600 companies will be represented.

But just as important is OTC's extensive technical program, which offers:

- Topical breakfasts and luncheons featuring senior executives of operating, service and supply companies who will share their views on future industry directions, operational integrity and risk management.
- Panel discussions led by experts and high-ranking government officials addressing issues related to public policy, energy development and health, safety and the environment.
- Peer-selected technical presentations on new technologies and lessons from the field.

And as in past years, AAPG will provide content for much of the technical program, including these AAPG-sponsored events:

Monday (May 5)

7:30-9 a.m. – Breakfast, featuring Silvia Peppoloni, on "Geoethics: A Way of Thinking and Practicing Geosciences."

9:30-noon – Session on "Monitoring Techniques and Systems, Cradle to Cradle – A Vital Input to Reliability and Integrity Management Programs."

2-4:30 p.m. – Session on "New Geophysical Approaches for Geohazard Consideration."

Tuesday (May 6)

- 7:30-9 a.m. – Breakfast, featuring Kelley Elliott, 2020 LLC/Acentia Company contractor to NOAA Office of Ocean Exploration and Research, on "Community-Driven, Telepresence-Enabled Ocean Exploration on NOAA Ship Okeanos Explorer."
- 9:30-noon – Session on "Marine Archaeology and Environmental Studies in the Offshore Oil and Gas Industry."
- 2-4:30 p.m. – Session on "Emerging Offshore Geosciences Technologies.
- 4:45-6:30 p.m. – Reception, sponsored by AAPG and SEG, to promote "Geosciences Day."

Wednesday (May 7)

- 9:30-noon – Session on "Law of the Sea."
- 2-4:30 p.m. – Technical sessions:

✓ "Petrotechnical Data Donation to Universities – Symposium on Results."

✓ "Methane Hydrate Case Studies."

✓ "Metocean – New Developments and Perspectives."

Thursday (May 8)

- 9:30-noon – Technical sessions:

✓ "Development in Geotechnical Engineering."

✓ "Global Review and Exploration for Methane Hydrates.

- 2-4:30 p.m. – Technical session on "Underwater Monitoring Network: Strategy and Case Studies."

For more information go to the website at www.otcnet.org.

Untold quantities await discovery

Global Focus on Gas Hydrates Growing

By DAVID BROWN, EXPLORER Correspondent

No one knows for certain how much methane might be produced from gas hydrates, or even the total quantity of gas hydrates on the planet.

That doesn't mean there aren't some wild numbers floating around.

When the Potential Gas Committee at the Colorado School of Mines increased its estimate of United States natural gas resources by 486 trillion cubic feet (Tcf), it was major news.

The increase in U.S. production potential because of shale gas and other unconventional resource plays was called a "game-changer."

Qatar claims the largest non-associated natural gas reservoir in the world, the North Gas Field, estimated at 900 Tcf.

By comparison, some estimates of the world's gas hydrates production potential are well above 10,000 Tcf.

For years, the oil and gas industry viewed gas hydrates as something obscure and exotic. You can flip that around completely.

When experts talk about gas hydrates now, they use terms familiar to the industry:

Seismic exploration.

Petroleum system analysis.

Vertical well development.

That shift to familiar territory is probably the second most important thing to know about gas hydrates today.

The most important thing to know is that commercial production of gas hydrates is close to reality.

COLLETT

> "We're not talking about dredging the seafloor. We're talking about conventional approaches."

Or at least, closer.

And a third thing to know is that the resource potential of gas hydrates is still primarily a matter of exploration.

Japan Takes the Lead

Interest in gas hydrates production intensified last year after Japan successfully extracted and produced methane from hydrates in the Nankai Trough, said AAPG member Timothy Collett, senior scientist with the U.S. Geological Survey (USGS) in Denver.

The production test was conducted by the Japan Oil, Gas and Metals National Corporation, or JOGMEC.

"The highlight by far is the significant contribution from Japan" Collett said. "JOGMEC has the national gas hydrates program in Japan. It's the first production test for hydrates from a marine environment."

Collett is co-chair of the session "Global Review and Exploration for Methane Hydrates," which will be held May 8 at the Offshore Technology Conference in Houston, where speakers will discuss developments in gas hydrates exploration as well as specifics of accumulations offshore Japan and India and in the Gulf of Mexico.

Japan's gas hydrates program has a goal of fully understanding economic production by 2018, according to Collett.

"We'd consider that very optimistic, but they've shown the ability to stay on track for that date," he said.

The United States conducts its own methane hydrates research through studies by the USGS and programs funded by the Department of Energy's National Energy Technology Laboratory (NETL).

NETL recently issued a funding opportunity announcement aimed at an extended-duration test program in Alaska and an investigation of the occurrence and nature of methane hydrates on the U.S. Outer Continental Shelf.

Pressure Cores

Today, much of the key work on production from methane hydrates is being done in Asia.

"Japan's been at this since 1995. We started in 2000," said Ray Boswell, technology manager in Pittsburgh for NETL's Natural Gas Technologies Program.

Economics and the desire to secure future energy supply are driving the Asian work on gas hydrates. Japan, Korea, China and India all have national programs targeting methane production from hydrates, Collett noted.

Japan, especially, lacks domestic energy resources and hopes to develop a gas hydrates resource. Import LNG prices in Japan reached $17 per million Btu earlier this year. At the same time, the country has moved away from nuclear power as an energy source.

In 2012, Japanese researchers obtained gas hydrates sediment samples, known as "pressure cores," in cooperation with the USGS Gas Hydrates Project and the School of Civil and Environmental Engineering at Georgia Tech University.

"You try to keep it from dissociating,"

See **Hydrates**, page 20

Hydrates
from page 18

Boswell said. "We've got some devices where you can collect those pressure cores and preserve them, and transfer them to other devices where you can study them."

Then last year, JOGMEC was able to conduct an extended gas hydrates production project.

"They flowed gas to surface immediately and sustained that rate for six days," Boswell said. "It took a considerable investment for Japan to do this."

Only limited information about the production results have been released, so interest is high in the OTC session "Invited Organization (JOGMEC)" on May 7, where speakers will discuss the project.

> **"We have made a very big advance in recent years in finding that the geological-geophysical approach works."**

A Very Good Fit

OTC this year will feature two additional sessions on gas hydrates:

- "Methane Hydrate Case Studies," also on May 7.
- "Modeling and Laboratory Studies for Methane Hydrates" on May 8.

Methane can be produced from gas hydrates by various methods, but the leading contender for commercial production is depressurization, according to Boswell.

"That's a relatively simple process of drawing from the reservoir with a pump. It might need to be augmented – add heat, enhance flow pathways," he commented. "I think what people want to get a handle on now is what rates (of production) you will get with depressurization."

In depressurization, a well is drilled into a gas hydrates accumulation. Water is pumped out to reduce pressure, so methane will dissociate from the gas hydrates clathrate lattice. The methane then can be produced through the wellbore.

So far, "all of the tests have been vertical," Boswell noted. "The tests have been very scientific. They haven't attempted to maximize production, at least not yet."

With rates of production and potential rates of return still a mystery, whether or not gas hydrates production will be economic is an unanswered question.

"You have to answer that question based on where you're sitting at any particular date," Collett said.

High consumer prices for natural gas at the burner-tip in Asia may help gas hydrates look attractive economically. By contrast, resource plays in the United States have produced an abundance of natural gas at low prices.

There's no doubt that a shift in thinking has made methane from gas hydrates more familiar as a resource in the energy industry.

"We're not talking about dredging the seafloor. We're talking about conventional approaches," Collett said. "We've seen this very important progression in our thinking that is even now beginning to fall over into the production side."

Hydrates "do fit the petroleum systems model well," he noted. And studies have identified sand-dominated reservoirs as providing the most favorable potential for production.

That potential often is presented as a resource pyramid, with sands at the top, followed by clay-dominated fractured reservoirs, massive gas-hydrate formations exposed on the seafloor and low-concentration, disseminated deposits at the bottom.

It might happen that only the top of the pyramid, the most promising sands, will be true reservoirs for economic hydrates production. At the moment, nobody knows how large that resource would turn out to be.

"The U.S. program has a goal of understanding the wide range of issues associated with gas hydrates. Resource potential is one of those," Boswell said. "One of the bigger issues is that very few of the prospective areas have been explored."

Seismic analysis is now used to study the presence, properties and distribution of gas hydrates, especially in marine settings.

"I think," Boswell said, "we have made a very big advance in recent years in finding that the geological-geophysical approach works."

Getting Up to Speed

Getting a firm estimate of the world's gas hydrates resource in place will require more exploration, and a lot more time.

Collett said he doesn't think the numbers published so far have any relevance.

"We would never use the word 'reserves'" when talking about methane hydrates, he commented.

For the most part, methane from gas hydrates has stayed under the radar as a potential energy source. That could be because the scientific understanding of gas hydrates as a resource is a relatively new thing.

"If you just go back 20 years, gas hydrates in nature were poorly understood," Collett said. "They're not completely well understood today."

But gas hydrates have begun to emerge as a possible future energy source, and the recent work in Japan has drawn the world's interest.

"There are four sessions (related to gas hydrates) at OTC, which is quite a big percentage of OTC's available block of sessions," Boswell noted. "It certainly is a good place for people to get caught up on the latest."

Finding a niche in fluid inclusion

Free at Last! Unlocking Trapped Volatiles

By LOUISE S. DURHAM, EXPLORER Correspondent

Mention fluid inclusions in subsurface rocks to someone, and it's quite likely to conjure up thoughts of fluid-filled pores.

Not so.

"Trapped fluids, which we refer to interchangeably with volatiles, are basically anything that occupied the pore at one time and got trapped in rock – but as a fluid," said AAPG member Don Hall, president of Tulsa-based Fluid Inclusions Technology (FIT), which was founded about 17 years ago as a spinoff of the old Amoco Technologies Center.

The company's forte includes lab-based chemical analysis of micron-size trapped fluid samples in rock material, i.e. fluid inclusion stratigraphy (FIS).

Among other specialties, it also focuses on analysis of entrained volatiles in drilling fluids, i.e. mud gas, with direct quadrupole mass spectrometry (DQMS). This instrumentation is uniquely suited for organic-based mud systems, which ordinarily hinder data analysis from other devices.

Hall elaborated further on the esoteric fluid inclusions, which quite often can be a major assist to geoscientists.

"These inclusions are microscopic traces of past or now-existing subsurface fluids that became entrapped in rocks during burial," he noted. "They are completely encapsulated within their host minerals and, consequently, are distinctive from adsorbed or residual fluids in open porosity.

"The result," he said, "is they are not subject to evaporation during sample storage, loss of light ends during sampling from depth, or contamination from the mud system."

Small, But Important

A crucial aspect of these fluid inclusions, according to Hall, is that they endure in the geologic record although the parent fluids move on. As a result, a given sample contains the fluid history of the area.

In other words, despite being microscopic they're jam-packed with information.

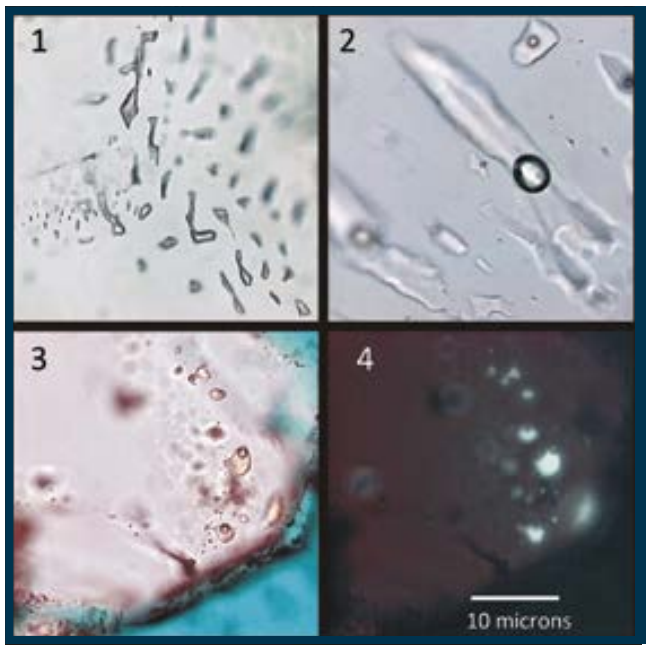
Specific tests can be done on these inclusions to study processes occurring within the earth, such as migration and accumulation of oil and gas.

"We analyze what you can volatilize in a vacuum chamber under elevated conditions," said Mike Sterner, vice president of R&D at the company. "Because you're opening up (rock material) in a vacuum, the solids are left behind as evaporative residue, so we're truly looking at basically fluids.

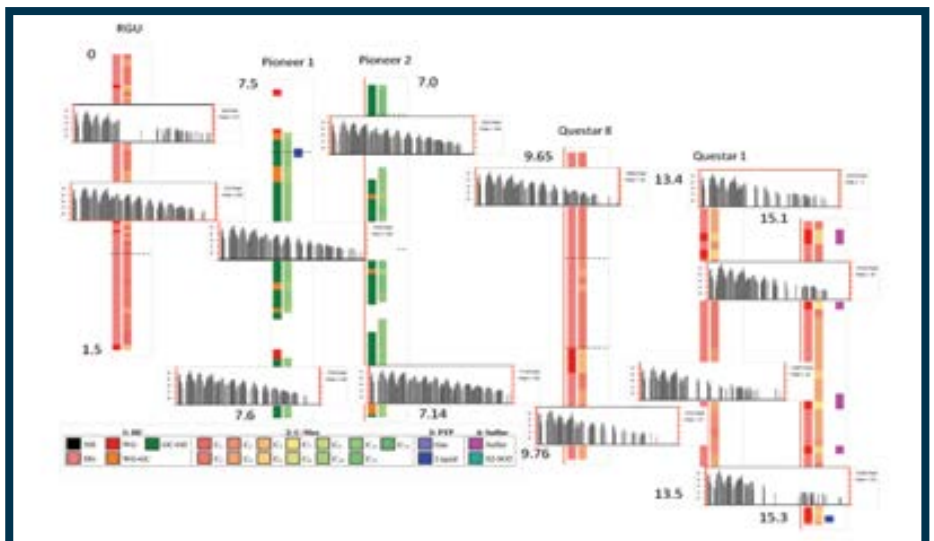
"Virtually any question that involves the present or past distribution of petroleum, its chemical characteristics, and relationship to the rock/pore system can be addressed using FIS," Sterner added.

The array of applications include:

- Migration, charge/paleo charge, fluid contacts.
- Petroleum type, quality, multiple charges.
- Inference of nearby undrilled accumulations.
- Microseepage, deeper potential.
- Seals, compartmentalization.



Fluid inclusions in sandstone under a petrographic microscope: 1) dry gas; 2) brine; 3) moderate gravity oil under plane light; 4) same image under ultraviolet illumination.



FIS-derived trapped fluid composition (hydrocarbon type) and representative mass spectra from Mancos Formation cores, Utah. Numbers are measured depths divided by 1,000. Data can be used to evaluate distribution of fluid types within emerging plays at an early stage using archived samples from old wells.

FIS Helps Find Sweet Spots

By LOUISE S. DURHAM, EXPLORER Correspondent

Fluid Inclusion Stratigraphy (FIS) has been used for decades to successfully evaluate critical aspects of petroleum systems, such as reservoir content, phase state, seal effectiveness and migration pathways, according to AAPG member David Wavrek, president of Petroleum Systems International in Salt Lake City.

FIS entails rapid complete analysis of volatiles trapped as fluid inclusions in cuttings, core or outcrop samples using quadrupole mass analyzers attached to an automated attached, high-volume sample introduction system.

"In conventional reservoirs, most volatiles will have been trapped as fluid moves through rock, or warehoused in the porosity in the rock," said AAPG member Don Hall at Fluid Inclusion Technologies.

"Because unconventionals are self-sourced, the fluids we're looking at there are more likely to be related to the process that created the hydrocarbons in the first place," he said. "So part of them got entrapped in some kind of pore space and got crystallographically sequestered by some process.

"All diagenetic minerals are growing from a fluid," he noted. "That fluid gets trapped in the mineral itself sometimes because there could be little aberrations in the crystal, and the mineral can't get its act together and kind of overgrows that piece, leaving part of the fluid behind.

"That would be fluid inclusion," he said.

"If you fracture a rock, the fracture surface will be invaded by fluid that most likely won't be able to get out of the fracture completely," Hall noted. "The fracture will heal like a wound and leave behind this little residue that's crystallographically encapsulated within the fracture plane.

"In unconventional rocks, some of the pores, porosity or whatever that collect these fluids are nanopores that basically are partly converted kerogen," he said. "They take on a spongy looking, holey network that people have imaged.

"Those are so tiny and disconnected that they can't enable themselves to flush out fluid effectively," he continued. "So in unconventional reservoirs, a lot of the fluids we're analyzing are effectively encapsulated in these nanopores that aren't released until you crush the rock, or when drilling is complete and you create a bunch of introduced fractures that try to connect these little pore spaces together."

even prior to leasing.

The increasing use of advanced geochemical techniques is paying off for those companies choosing to implement them not just for evaluation of conventional reservoirs but the always-challenging unconventional as well, according to Hall.

With regard to unconventionals, those unavoidable by-products of drilling – borehole gas and drill cuttings – play a big role.

The most practical applications of cuttings volatile data to these type reservoirs zero in on predicting fluid type, composition, quality and volume in tight rock. Additionally, these data can be used to identify variability that occurs along the laterals to exploit them for more effective completions.

Hall noted that one of the most promising new methodologies is the complementary combination of:

- Advanced mud gas analysis in the field using gas chromatography, mass spectrometry, or a coupling of the two.
- Comprehensive cuttings analysis for trapped fluids and elemental and mineralogical content in the lab.

Operators have a leg up with unconventional plays, which ordinarily are the scene of many historical vertical penetrations. This means that rock-fluid databases can be established quickly and cost-effectively early on without drilling new wells, using small amounts of readily accessible archived cuttings.

The new PetroFecta application is the latest technology in the fluid inclusions toolkit. This new package combines XRF, trapped fluid analysis and high-resolution photography of the entire wellbore from well cuttings or core samples of any age.

It's been used successfully on certain shales, whether cores or cuttings.

In one instance, an operator wanted to better define the thermal maturity in the rocks and across a basin being studied and was getting some conflicting signals from some other data.

"Validating gas shale thermal maturity assessments based on standard source rock data is advisable," Hall said. "It's particularly prudent where you're modeling the composition of the hydrocarbon fluids within the reservoir, and the regional thermal maturity is believed to straddle the oil, wet-gas/condensate and dry gas windows.

"In a frontier basin such as this, where data are sparse, we added mass spectroscopic evaluation of hydrocarbon fluid inclusions and fluid inclusion thermometry to pull added information from the few well samples available," he noted.

"The goal was to understand how potential fluid compositions might vary across the basin with maturity.

"Fluid inclusion fluorescence revealed two populations of inclusions, highlighting differences in the timing of inclusion formation," he said. "This was in sync with two heating periods and essentially underscored the belief that the original basin assessment was basically on target.

"It was time to discount the varied data that had provided conflicting information early on."

See **FIT**, page 24

Jason

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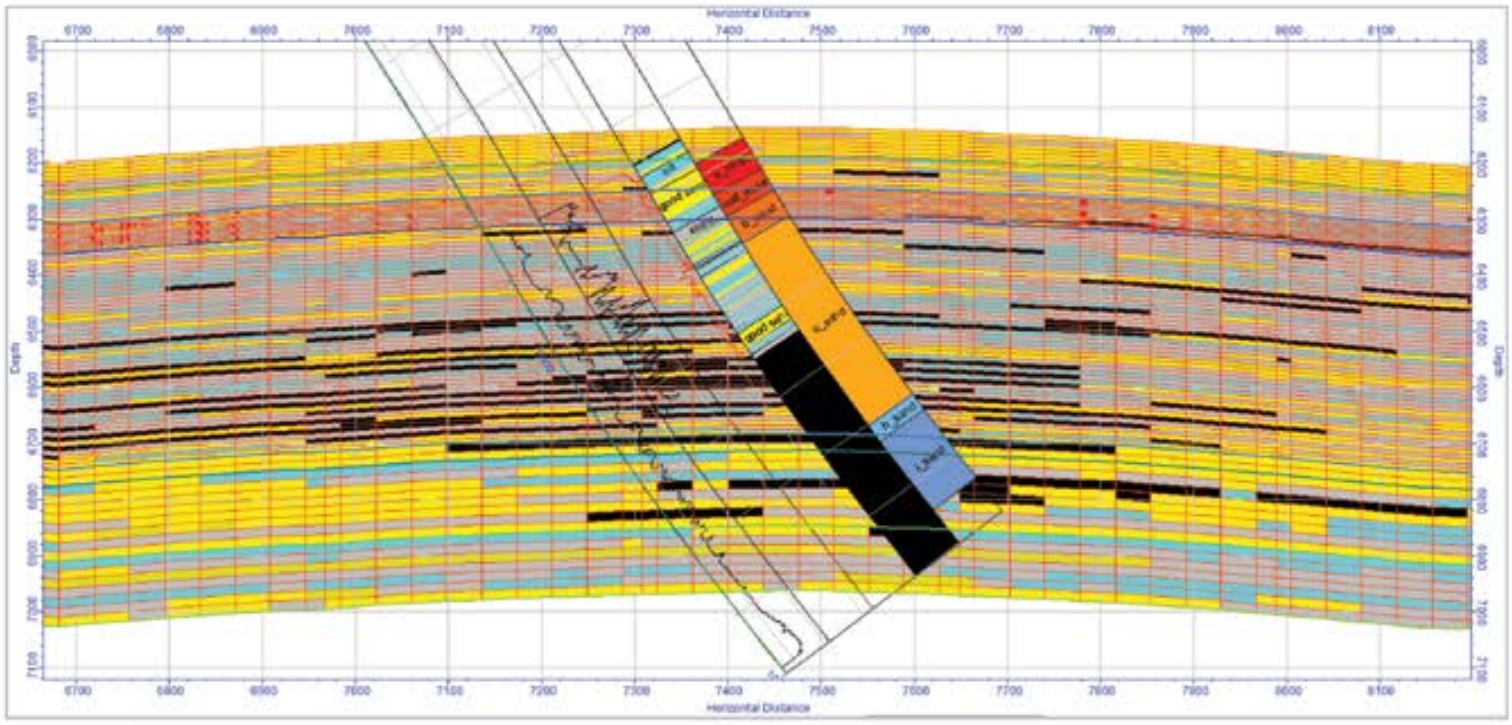

3D model cross section of distributed facies with a deviated well displaying discrete and continuous logs.

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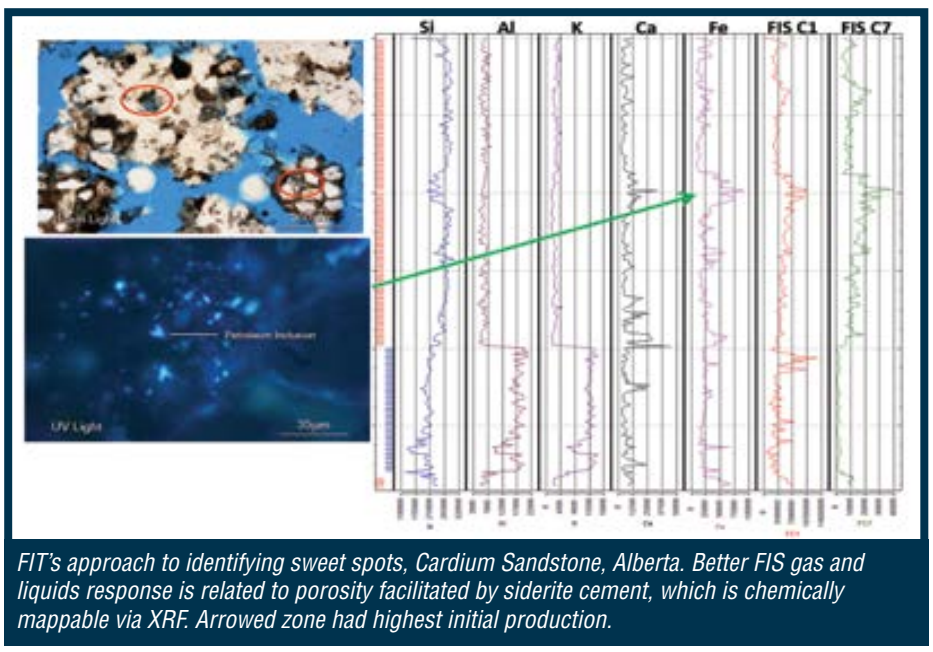


FIT's approach to identifying sweet spots, Cardium Sandstone, Alberta. Better FIS gas and liquids response is related to porosity facilitated by siderite cement, which is chemically mappable via XRF. Arrowed zone had highest initial production.

FIT

from page 22

Seeking an Advantage

Regarding the company's dq1000 mud gas mass spectrometer, which provides advanced mud gas analysis at the well site, Sterner said it is applied via companies who lease the equipment.

It has been used in a variety of locales, including the high profile Haynesville shale.

"It's extremely sensitive instrumentation," he said.

Rife Resources in Calgary has applied the on-site gas analysis methodology with success but concentrates for the most part on the advantages that the FIS lab-based analysis provides.

"In various different companies I've been involved with, we've used it on different rock types and different depositional environments and stratigraphic settings," said AAPG member Scott Hadley," president of exploration at Rife and former colleague of Hall at Amoco. "We currently have an unconventional project going in the Montney, where we're analyzing cuttings.

"One of the things that's a challenge is that we have to do more things with the rock itself," Hadley emphasized.

"It's very expensive to put logging tools in these horizontals," he said. "Even though everyone would want to have this, it's usually not a reality at the end of a very expensive well.

"One thing we're kind of guaranteed during drilling is we'll be bringing rock material to the surface," he commented. "I like these fluid inclusion techniques because it's a thing we can do with the rock that's relatively cost effective.

"We're looking for changes or relationships we can tie back to anything that might give us an advantage with respect to placement of wells or designing fracs relative to what we've seen in the rocks," Hadley noted.

"We can do what I liken to a chemical stratigraphic profile of a well – what's actually in the rock based on the fluid inclusion component.

"We can drill a vertical stratigraphic test and chemically profile it," he said. "We can typically acquire a log easier in the vertical well than the horizontal, so we can tie the fluid inclusion/chemical stratigraphy back to the log response and other things you might characterize as being in the system."

The Preferred Spot

Based on all of these analyses, he noted that they can pick the preferred spot to land the horizontal.

"If there is a more chemical signature, maybe a zone with an abundance of fluid inclusions that show liquids-rich gas or condensate, that would be something we could integrate.

"We could tie back and say we want to drill horizontal targeting that chemical profile," Hadley said. "As we drill laterally, we get cuttings and can compare/contrast relative changes in that chemical profile back to our vertical and kind of situate where we are in that geological space."

He sees this as preferable to placing expensive logging tools in the wellbore, which can lead to expensive rig time along with the potential risk of losing tools downhole.

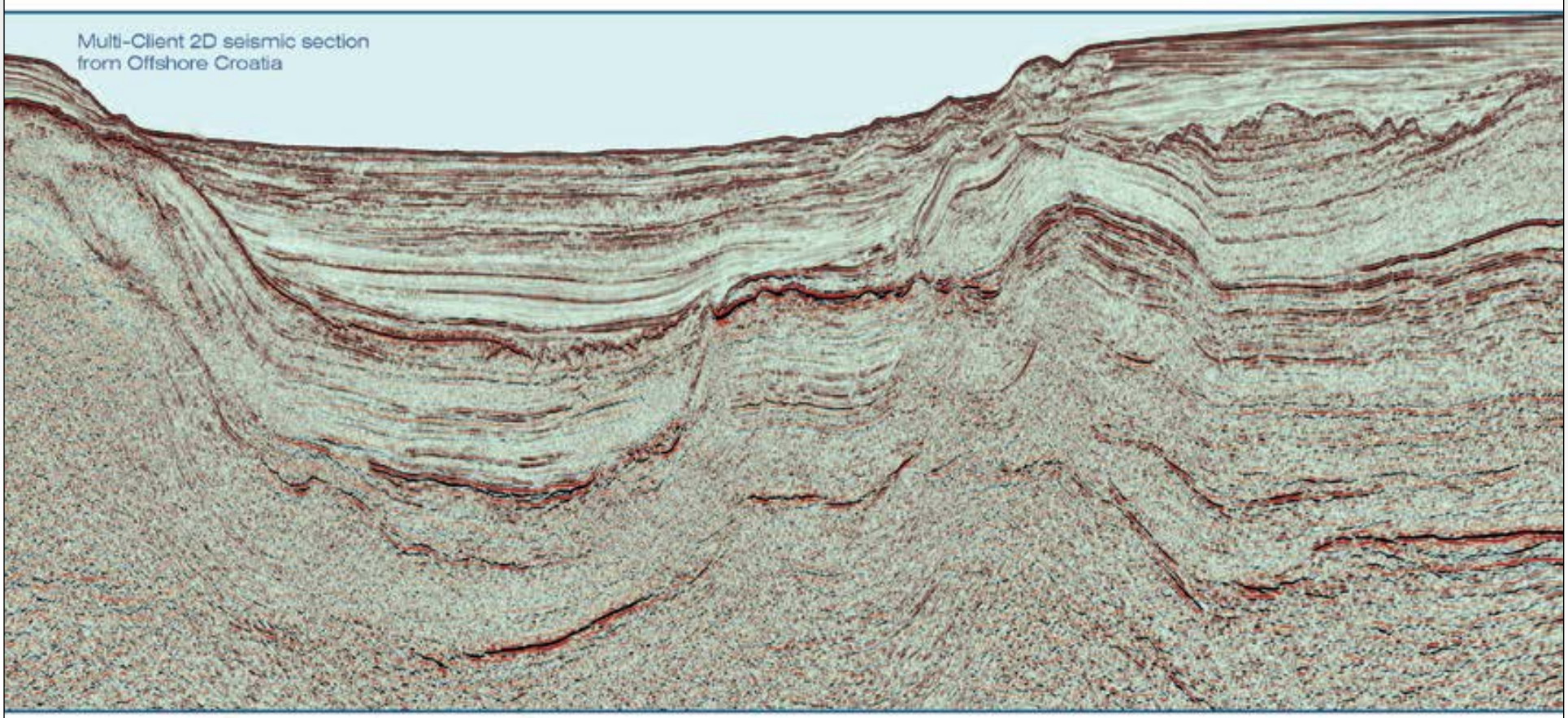
With cuttings being a by-product of drilling, there are plenty of opportunities and time to design the sample frequency, which can be every couple of feet or whatever. And there's no time spent trying to convince management to ok the deployment of logging tools.

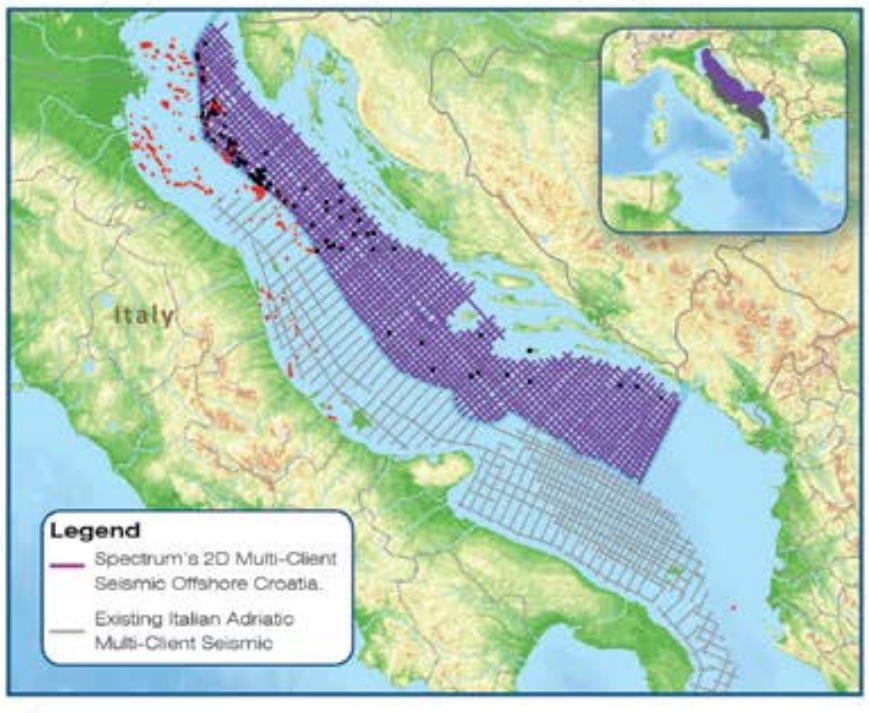
"We must be able to explore some of these technologies that are rock-based solutions that will compare and contrast the type of response you get back and try to explain the differences we see in certain trends," Hadley said.

"We like to use it as a tie to the environment we're in," he said, "as well as trying to understand the vertical profiling and layering that might be in these big thick unconventional sequences."

Offshore Croatia

A New Oil Province at the Heart of Europe





Spectrum has acquired a truly unique Multi-Client seismic survey offshore Croatia. This is the only seismic data available to license in this hugely underexplored region which has now opened its first offshore licensing round.

The survey, acquired under contract to the Ministry of the Economy in Croatia, covers approximately 14,700 kilometers of long offset seismic data with a 5 km x 5 km grid. It extends across most of the Croatian Adriatic Sea and connects with Spectrum's reprocessed seismic data covering the Italian Adriatic Sea.

Final PSTM data has now been delivered and all processed data will be available by the end of April. The Government of Croatia opened its licensing round over the country's offshore continental shelf in Zagreb, Croatia, on the 2nd of April.

Spectrum

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mc-uk@spectrumasa.com
www.spectrumasa.com

Microseismic Monitoring Delivers the Big Picture

By KEN MILAM, EXPLORER Correspondent

Success may breed success, but it takes effort.

As success in shale plays has grown, so has the pressure to keep the production flowing.

Microseismic is one of the tools that have grown in popularity as it has helped producers answer one of the biggest questions they face: Where to drill next?


DUNCAN

It continues to evolve and remain an important component in ensuring future success, according to its proponents.

AAPG member Peter Duncan, founder and CEO of Houston-based MicroSeismic, will discuss the achievements and promise of the technology during a panel discussion on Emerging Offshore Geosciences Technologies at the upcoming Offshore Technology Conference in Houston.

"Microseismic monitoring is to fracing as logging is to drilling," Duncan said in a recent interview with the EXPLORER.

Microseismic helps show which parts of a reservoir are draining, thus pointing to the best areas to put future wells, Duncan said.

"Without it you are really making some pretty large assumptions about what happened when you treated the well," Duncan said. "What operators want to know most is what volume of the reservoir is a well going to effectively drain over its life and, hence, where should they drill its nearest neighbor.

"Optimal well spacing," he said, "is what operators need to know."

Positive Factors

According to Duncan, two factors have contributed to the increased use of microseismic in the last decade.

"The first is that operators have become increasingly aware of the complexity of the shale plays and, consequently, the need to monitor a larger proportion of their fracs to get a more complete picture of how the rocks are responding to stimulation," he said.

"The second is that over the last 10 years we have learned to pull more valuable information out of the monitoring data."

"Microseismic monitoring, in common with most geophysical techniques, seems to work better in some plays than in others. The Eagle Ford, Marcellus, Utica and Horn River Basin deliver some of the best monitoring results that we have seen so far," said Duncan, whose company serves operators of all sizes.

Duncan said the technology, while not really young, continues to develop.

"We have only scratched the surface of what reservoir knowledge can be gleaned from the monitoring datasets," he said.

"As we learn to integrate the monitoring responses with the other geological, geomechanical and geophysical data available on the reservoir, I believe we will move to monitoring every well in real time," he said, "rather like logging while drilling – first determining the template upon which the field should be developed and then assessing each well as it is drilled in order to respond to any changes in the reservoir that are encountered," he said.

AAPG member Peter Duncan, with Houston-based MicroSeismic Inc., will be part of a panel discussing "Emerging Offshore Geosciences Technologies" at the upcoming Offshore Technology Conference, set May 5-8 at Reliant Park, Houston.

This year's event marks the 45th anniversary of OTC, which has become one of the industry's largest gatherings. AAPG is a sponsoring organization and annually a key contributor to the technical program.

The panel on "Emerging Offshore Geosciences Technologies" will be held at 9:30 a.m. to noon on Monday, May 5.

Others on the panel include:

- Paulo Roberto Johann, with Petrobras America.
- David James Monk, with Apache Corp.
- Shuki Ronen, with Seabird Geosolutions.
- Rocco Detomo, consultant.

RMS Annual Meeting Set for Denver

"Cracking the Source" is the theme for this year's Rocky Mountain Section meeting, slated July 20-22 at the Colorado Convention Center in Denver.

The theme is intended to focus on the source rocks of the Rocky Mountain area and their impact on the unconventional resources of the region.

The meeting, hosted by the Rocky Mountain Association of Geologists, will include over 100 presentations covering not only source rocks, but also other topics such as technologies used in the identification, characterization and exploitation of these reservoirs, and new insights on the structure and stratigraphy of the Rockies and beyond.

Presentations will range from oral to poster to core poster.

Also offered are four field trips, with one especially designed and offered for young professionals and students: It will tour the outcrops near the city with a focus on the region's structure and stratigraphy.

The three other field trips, open to all geologists, are:

- One that focuses on the strata of the Eagle Basin.
- Two to study the Cretaceous and Paleozoic reservoir rocks, respectively, of the Denver Basin.

Those registering for the meeting before June 1 can save $100 in fees.

For registration, exhibitor and sponsor opportunities, and other information, visit the website at www.aapgrms.org/2014.

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PURPOSE DRIVEN

University of Louisiana at Lafayette Takes the Top Prize in Houston

Geoscience students from the University of Louisiana at Lafayette, representing the Gulf Coast Section, took home the top prize in this year's AAPG/AAPG Foundation's Imperial Barrel Award competition, which included an individual medal for each team member plus a $20,000 scholarship donation for their school (see related story below).

The University of Oklahoma, representing the Mid-Continent Section, finished second, and so received the Selley Cup, plus individual medals for all team members and a $10,000 scholarship donation for their school.

The Colorado School of Mines, representing the Rocky Mountain Section, was the third place winner and received the Stoneley Medal, individual medals for all of the team members plus a $5,000 scholarship donation for their school.

The IBA competition is open to all universities with enough qualified students and a willing faculty advisor. This year's competition attracted teams from 125 schools from 36 countries, involving nearly 1,000 participants. All competed at a Region or Section semi-final competition, with the top team from each of those events earning the right to compete in Houston at the IBA final, held the weekend before AAPG's Annual Convention and Exhibition (ACE).

At the final, each team was allowed 25 minutes to give a presentation on the interpretation and assessment of an exploration data package. The technical evaluation and an exploration strategy were presented in front of a panel of judges comprising top industry experts. The judges assessed the quality of the work, ranked the teams and determined the winners.

For participating in the finals, all schools automatically receive $1,000 in scholarship donations as winners of their respective Sections and Regions.

Other schools that were represented in the IBA completion representing the AAPG Sections were:

- Penn State University (Eastern Section).
- San Diego State University (Pacific Section).
- Texas Christian University (Southwest Section).

Teams representing the AAPG Regions were:

- University of the Western Cape South Africa (Africa Region).
- Australian School of Petroleum, University of Adelaide (Asia-Pacific Region).
- University of Alberta (Canada Region).
- IFP School (European Region).
- Universidad Nacional Autonoma de Mexico (Latin American Region).
- Sultan Qaboos University (Middle East Region).

Once Was Not Enough: ULL Makes IBA History

By BARRY FRIEDMAN, EXPLORER Correspondent

The University of Louisiana at Lafayette has won the 2014 Imperial Barrel Award.

If it sounds like you already have read this story once before, perhaps you have.

Back in 2012, the school also won.

That's not supposed to happen. Check that. It doesn't happen. No school has *ever* won twice, which brings us to a school in southwest Louisiana with a little under 18,000 students, a school that would appreciate it if you got its name right: The University of Louisiana at Lafayette.

The team adviser then, the team adviser now, is AAPG member Brian Lock, an award-winning professor of geology and the department's graduate school coordinator; and he was confident of this year's victory all the way – except for the moments he wasn't.

"I had seen several other presentations, possible because our team went early, and I had been particularly impressed by the Colorado School of Mines presentation – really professional! – and had hoped for a second or third place for UL Lafayette," Lock said of the global competition.

"So when CSM was announced as third place winner, I would have taken bets that we were out of the money," he continued. "Then Oklahoma was announced second, and I was even more convinced we were going home empty handed."

And then …

"The announcement of first place seemed to be in slow motion and it really took a moment to sink in," he said. "University of Louisiana at Lafayette! What a euphoric feeling!"

Brian Lock and the IBA-winning team from the University of Louisiana at Lafayette.

It Takes a Team

UL Lafayette has competed in the global tournament every year since the program was expanded in 2008. This year the school was one of 122 schools from across the United States and six international regions that entered the contest.

"Being the first team to win the competition twice is really special, but I am sure there were many people not familiar with the program who have been continually surprised by our performance at the Section level," said Lock, who has won an A.I. Levorsen Award, plus AAPG's Distinguished Service and the Grover E. Murray Memorial Distinguished Educator awards.

One of the reasons for the surprise is the school's size. UL Lafayette has approximately 150 geology students. By contrast, the University of Texas has about 600, a fact not lost on Lock's students.

"Our continued success in the IBA competition not only does a great job of getting global exposure for our university, but it proves that we can compete with the larger, better funded programs and win," said AAPG member Jordy Babineaux, a member of the team.

"Our students," Lock added, "had really worked hard – eight- or nine-hour days, seven days a week throughout the eight weeks – and I was really pleased with the quality of their work and the strong sense of a team."

"The Dutch North Sea data set that our team was given included 13 previously drilled wells, 12 of which were dry holes," Babineaux said. "That was when we first realized this project was not going to be a cakewalk.

"Through the eight-week competition, we had to collectively piece together the basin history, interpret the 2-D and 3-D seismic data, determine why the previously drilled wells were failures and develop prospects that would be successful," he said. "We also had to figure out how to effectively communicate our ideas to a panel of industry experts within a 25-minute time frame."

Efforts – and Intangible Dynamics

Another student on the team, AAPG member Jolie Helm, said those 25 minutes were all-consuming. The judges, in fact, select the winning team based on technical quality, clarity and organizational skills.

"In preparation, we set timelines and goals for ourselves and literally lived this dataset every day for two months, and I think it showed in our presentations," she said. "It was grueling at times when we were working 50-plus hours a week, but the outcome was extremely rewarding."

As to the award itself, she said, "It felt very surreal that we won the competition; it definitely took some time to sink in."

Adding to how impressive this all is, Lock pointed out that his Region, the Gulf Coast, is a perennially strong arena (the University of Texas won the IBA in 2011), so it's not just enough for a team to do well – every school will do that – it has to do something special.

"In each round, though," Lock said of his students, "they pulled out everything they had and it turned out to be enough, although I doubt there was much room for the judges to choose between the top teams."

Often that distance between teams comes down to the intangibles, even the inexplicable, like the swimmer who eats the same meal before games, like the towel on which former UNLV basketball coach Jerry Tarkanian used to gnaw.

"One of the students had made a comment indicating he was somewhat superstitious – didn't want to change anything about our approach from the success," Locke said, referring to that first victory back in 2012, so he tried to replicate the lead-up.

"In Long Beach (2012) we spent the Saturday visiting the La Brea tar pits and museum, so this Saturday of the competition we went to the Houston Museum, and at the awards ceremony we again sat in the front row as a statement that we expected to win, just as we did in Long Beach."

Practical Petroleum Geology

For UL Lafayette, like all the schools in the competition, participation in the IBA competition is not just about the contest or the $20,000 first prize – which will be used to upgrade facilities and programs, provide scholarships, buy computers and software ("We are not well-funded compared with many other programs, and the award money definitely helps," Lock said) – but about its overall program, its day-to-day operations, its students preparedness.

"Our reputation has grown," Locke said. "Recruiters have become aware that we have a program strongly oriented toward practical, petroleum industry geology."

But he wants to underscore that none of it happens without a team of students, administrators and others.

"I cannot leave out a comment about the industry mentors for IBA," he said. "Without the time and trouble that these men and women provide, for little recognition, the IBA program would not be the success it is."

And here he mentions, specifically, the great work and passion of AAPG members Mary Broussard and Mike Quinn of Freeport-McMoRan Oil and Gas in Lafayette, who also are adjunct faculty members at the school.

Ultimately, Lock says the IBA winners, which, along with Helm and Babineaux, consisted of Sam Ely, Nicholas Geyer and Daniel Sutton. are now ready for the next contest: careers.

"The IBA competition is a fantastic opportunity for a lot of students to gain incredible experience," he said, "and I know that anyone who has 'IBA team' on his or her resume is sending a strong message – here is a bright, hard-working team player who is ready to take a place in our industry."

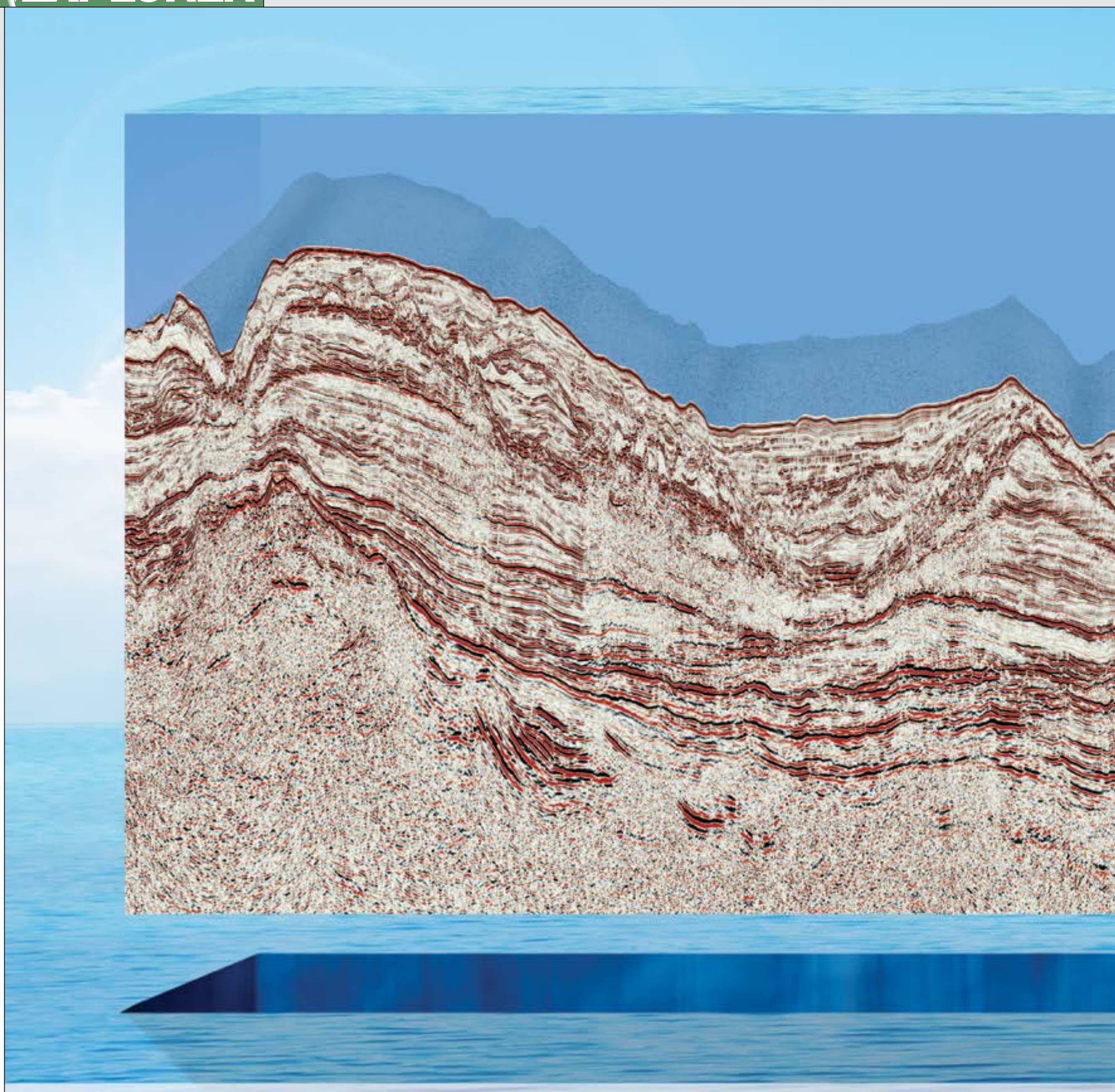
The team will you tell you it's more than that.

"I have a great sense of pride," Helm said, "in this school and the geology program."

A thought echoed by Babineaux.

"As geology students at the University of Louisiana at Lafayette, we are all well aware of how strong the geology program is here," he said, "but it is still not as well known as some of the geology programs at the larger universities."

It's known now.



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Exploration along the U.S. Atlantic

OCS: Potential Doesn't Always Ensure Success

By BOB ERLICH

When it comes to U.S. energy policy, there arguably is no topic that creates more heated debate than that of the federal OCS (Outer Continental Shelf) leasing program. The program and its future have been hot topics in recent presidential and gubernatorial elections, and the politicizing of this critical issue illustrates the passion that exists around the fate of the OCS.


ERLICH

Well-intentioned, intelligent people can be found on both sides of the argument, lobbying for and against the opening of U.S. East Coast continental shelf and deepwater areas to oil and gas exploration.

The current OCS five-year plan, set to expire in 2017, continues the decades-long moratorium against drilling along the U.S. Atlantic margins, a ban first instituted by President George H.W. Bush in 1990 and extended by Presidents Bill Clinton and Barak Obama.

Many in Congress and within state governments bordering key maritime areas of interest continue to argue for at least allowing seismic surveys to move forward (there are presently six companies with active permits to acquire data). There are even proponents for launching full area-wide exploration licensing in 2014.

As we mark the 30th anniversary of the final well drilled in the U.S. Atlantic OCS, it is appropriate to reflect on the events that led to the beginning and ending of exploration along the U.S. East Coast.

My part in this story began with Amoco in New Orleans in 1980, where I had the good fortune to be in the right place at the right time during some truly historic events.

In this regard the story told here might not reflect what many who were involved in the exploration of the East Coast OCS might recall, but what follows is how I remember it.

* * *

In the early 1970s the U.S. Geological Survey undertook a series of studies of the U.S. Atlantic margin in order to estimate the amount of oil and gas resources the U.S. government might expect to be found by exploration.

Ostensibly, the purpose behind the work was to derive an understanding of how and when to schedule leasing activities, primarily centered on finding new sources of domestic oil to prevent the types of severe oil shocks experienced in the 1967 and 1973 oil embargos.

Therefore, in 1974, President Nixon ordered the secretary of the U.S. Department of the Interior to triple the amount of acres offered in OCS sales.

As part of the assessment of this new acreage, USGS scientists and their academic colleagues already had begun the acquisition and interpretation of 2-D seismic from the Georges Bank to the Bahamas, and by the middle 1970s began to publish their findings.

Based on the initial results of the joint government/academic work, Congress approved the Department of the Interior (via the Bureau of Land Management) to establish a schedule of lease sales to be held in three Atlantic OCS "Planning Areas:"

Figure 1 – U.S. Department of the Interior OCS planning areas, circa 1979 (from the Federal Register, 1980). A 1980 version of this map shows the South Atlantic divided into a narrow coastal zone (named South Atlantic) and an outer shelf/deep water zone (named Blake Plateau).

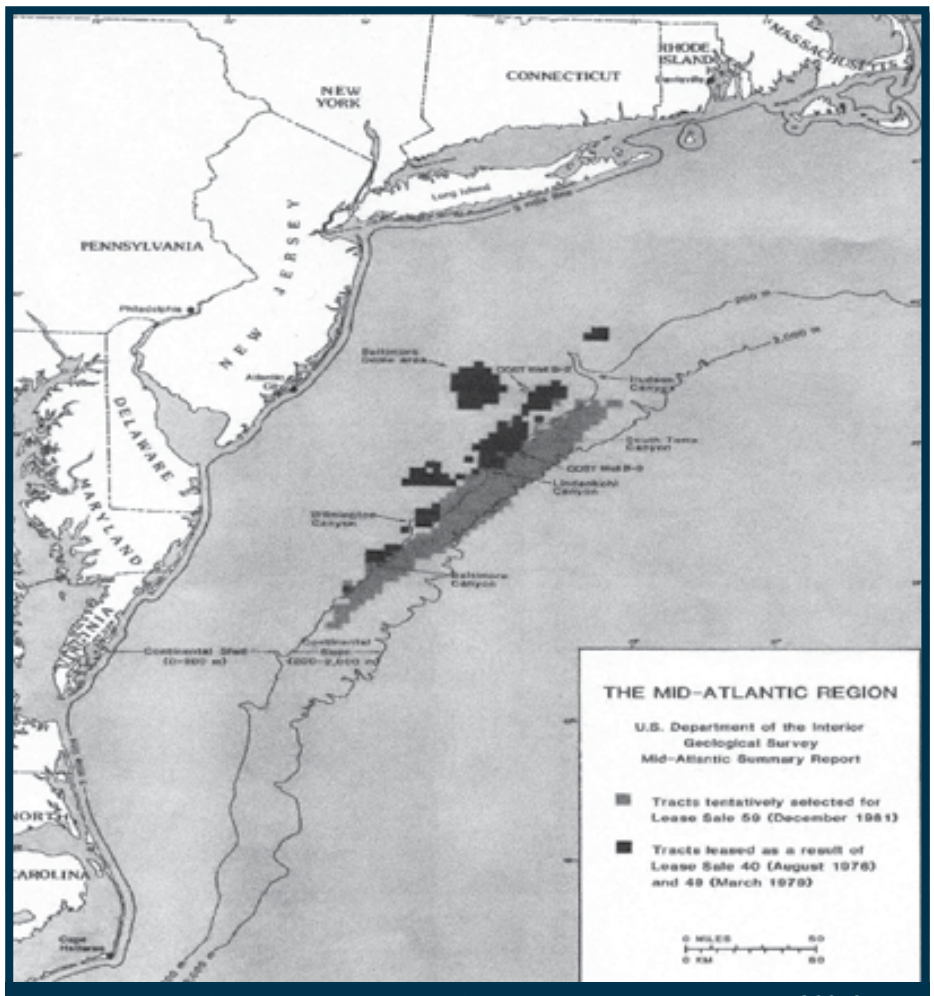

Figure 2 – Bureau of Land Management map of leased acreage in the Mid-Atlantic OCS, Sales 40, 49, 56 (proposed area), August 1981 (from McCord, 1981).

Virginia) and the South Atlantic (central Virginia south to the Gulf of Mexico).

The locations and sizes of the planning areas have been amended many times over the years such that many of the original sale boundaries, blocks and well locations now fall within planning areas redefined by the BOEM (Bureau of Ocean Energy Management) and its predecessor organization, the MMS (Minerals Management Service).

A fourth East Coast planning area, the Florida Straits (Central Florida to the Florida Keys), was transferred over from the Gulf of Mexico OCS in 1985.

The scheduling and exact geographic areas for the sales eventually were modified after consultations with the Natural Resources Defense Council.

Six months prior to the first Atlantic OCS licensing round, ODECO (now Diamond Stratigraphic Test) wells, and the well and previously contracted seismic data were made available to the industry.

Combined with data from a few relevant DSDP wells on both sides of the Atlantic, the industry prepared for the first lease sale, Sale 40, in what was then the Mid-Atlantic planning area.

Sales and a Key Partnership

Sale 40 did not move ahead without controversy, however, as images from the Santa Barbara Channel and ongoing Ixtoc disasters were fresh in the public's mind.

Numerous objections and protests were raised in an attempt to stop the auction, but to no avail. Even though there was much consternation about the potential environmental impact of exploration on the coastal states, many local and state officials also expected significant economic benefits from future exploration-related activities.

Despite this, the Interior Department still went ahead with Sale 40 on Aug. 17, 1976. The sale was historic for two reasons:

- It was the first sale ever held in the U.S. East Coast OCS.
- It was the only time high bid bonuses for an Atlantic planning area exceeded $1 billion ($4.6 billion in 2014 equivalent dollars).

Most of the majors and several independent companies participated, with Shell, Exxon, Texaco, Gulf, Mobil, Conoco, Tenneco, Murphy Oil and Houston Oil and Minerals being among the most active.

Amoco was notable for its absence.

The first well to be spud on a Sale 40 lease was by Exxon in Hudson Canyon Block 684, on March 29, 1978, followed in rapid succession by wells operated by Conoco, Texaco and Shell.

By the end of 1978, 12 wells had either been completed or were in the process of being drilled by seven different operators. Conoco's well in Hudson Canyon Block 590 reached TD first and was declared a dry hole.

By the second Mid-Atlantic sale (49) in February 1979, 10 dry or non-commercial wells already had been drilled, and the sale garnered little interest from industry (only $41.7 million in high bids in 1979 dollars). Local and state officials in the coastal states began to fear the worst – no "bonanza" from offshore drilling would be forthcoming – and each successive dry well or non-commercial declaration just added to the disappointment.

Undeterred, the BLM launched North Atlantic OCS Sale 42 in December 1979, the only sale ever held in this planning area. Renewed interest by industry was reflected in high bids of over $828 million ($2.7 billion in 2014 equivalent dollars). The (somewhat) logical assumption was that another Hibernia Field (discovered in October 1979 by Mobil) might be found off the Georges Bank, and companies scrambled for what they believed was the best acreage.

A hiatus of more than a year-and-a-half occurred before the first South Atlantic OCS sale (56) was held in August 1981. Again, pent-up industry demand was shown by high bids totaling $364 million (about $1.2 billion in 2014 equivalent dollars).

Sale 56 was truly a landmark for the East Coast OCS because of the aggressive bidding by the three-company partnership of Mobil, Marathon and Hess. Competing for blocks off North Carolina, the companies bid a record bonus of $103.8 million for one block ($266 million in 2014 equivalent dollars)!

This partnership won only five blocks in the sale but spent $234.7 million ($602 million in 2014 equivalent dollars), a record for an East Coast OCS sale.

Shell was a low-key participant and partnered with Chevron (as operator) and several other companies on only one block in the sale, while Amoco again did not participate.

Based on the high level of industry interest shown in Sale 56, Amoco made the decision to enter the East Coast OCS. Although Amoco was an experienced offshore driller, especially in the Gulf of Mexico, water depths over 1,000 meters

Continued on next page

Editor's note: Bob Erlich, an AAPG member, is vice president of exploration and new ventures for PanAtlantic Exploration. He has held a number of senior technical and executive positions during his 34-year career with companies such as Amoco, Burlington Resources, BP, Petrolifera and Hess. His assignments included work in Trinidad, Peru, Colombia, Venezuela, Argentina, Suriname, Brazil, Costa Rica, Panama, Guatemala, Equatorial Guinea, United Kingdom and People's Republic of China. He has published extensively on the geology of northern Latin America, with an emphasis on Cretaceous petroleum systems.

Continued from previous page

were beyond what the company felt it could handle on its own. An alliance with Shell made sense, because it was a natural outgrowth of Amoco's partnership in Shell's Cognac development, the Gulf's first deepwater (>1,000 feet) development.

So with the promise of big rewards ahead, Amoco, Shell (as operator) and Sun formed a partnership that bid on 53 blocks and won 42 in Sale 59 in December 1981 – including 15 key deepwater blocks.

The sale was heavily attended, with total high bids of $425 million (about $1.4 billion in 2014 equivalent dollars), despite the fact that many of the leases exceeded 1,000 meters water depth.

The partnership exposed $306.6 million in high bids ($717 million in 2014 equivalent dollars), including the high bid of the sale, $41.5 million ($97 million in 2014 equivalent dollars) for our most important block, Block 587.

Shell, bidding alone and with Murphy Oil, later won 18 key blocks in Sale 76 (April 1983) in Wilmington Canyon and the Baltimore Rise area. Amoco farmed-into 11 of the blocks a few months later in order to consolidate its lease position over the structures originally won in Sale 59. The companies bidding activities came to a close after Amoco, as sole bidder, won three blocks in the final East Coast OCS Sale (78) in the South Atlantic planning area.

Mid-Atlantic Bound

Following Sale 59, I was picked by Amoco to lead the exploration effort in the greater Mid-Atlantic OCS.

My geophysical teammate was George Kastritis, a lightning fast and accurate mapper in the days when colored pencils and paper sections served as "work stations." My principal equivalents on the Shell side were Rudy Lippert, an excellent and very experienced exploration geologist, and AAPG member "Chick" Voorhies, an equally experienced operations geologist.

Between us, we developed and recommended an exploration plan that proposed to drill and test what we all believed was a Jurassic to Lower Cretaceous carbonate shelf margin reef trend. Initially, the plan was to drill up to five wells, but we eventually decided on three very different locations so that we could test three different play types. A fourth well known internally as Eland later would be recommended on the Sale 76 acreage in the Baltimore Rise area to the south.

So what did we know about the geology of the area going into this risky and very expensive program?

- We knew that oil and gas in commercial quantities had been discovered years before on the Scotian Shelf (Sable Island/Cohasset) and in the Jeanne d'Arc Basin off the Grand Banks, Newfoundland (Hibernia) in Canada; Shell's and Amoco's involvement in offshore Canada plus the companies regional geologic work projected the same source rocks down to the Mid-Atlantic OCS area.
- Additionally, excellent work had been done by the USGS scientists and their colleagues in academia, and we now had the data from all five COST wells, the DSDP wells and test results from key shelf wells drilled by Texaco, Tenneco and Exxon that flowed gas, condensate and oil at potentially commercial rates.

Rudy had been involved with Shell's unsuccessful drilling on the Great Stone Dome, an enormous igneous intrusive, and integrated his and Shell's extensive knowledge of the stratigraphy into our prognosis for the back reef locations. I plunged into the seismic stratigraphy, still an emerging concept in 1982 and in those days more art than science.

Between us, we felt we had the technical support we needed to justify our play concepts.

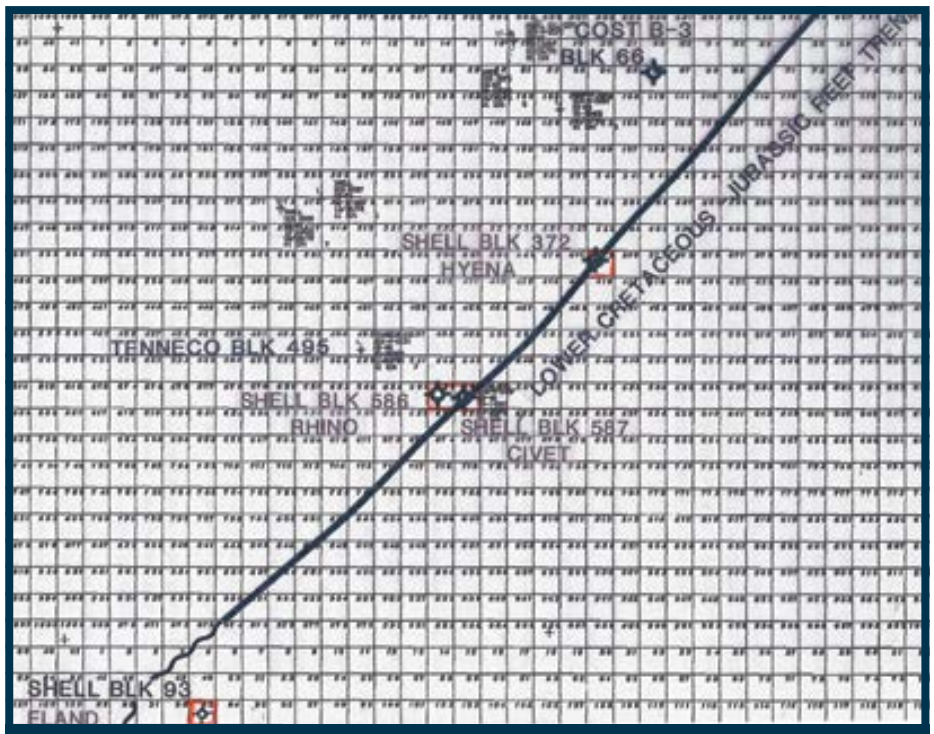

Figure 3 – Amoco Mid-Atlantic block map (parts of the Baltimore Rise, Wilmington Canyon and Hudson Canyon areas) from late 1984 showing the locations of the Civet, Rhino, Hyena and Eland wells. Scale: 1 block = 9 mi2.

Management Steps Up

High-level technical and management meetings between the partners took place during the week of Sept. 20, 1982, to confirm the upcoming drilling plans.

The companies collectively decided that:

- The first well would be located on what Shell called the "Civet" prospect in Wilmington Canyon Block 587, a linear structural high of about 130 square kilometers (50 square miles) focused along the Jurassic shelf margin. It was about the same size as our analogue, Kirkuk Field in Iraq, and if it worked, we would be fine with everything that happened afterward.
- The second well was to be drilled on the "Rhino" prospect, a large four-way anticline within the back-reef facies tract, just west of Civet in Wilmington Canyon Block 586.
- Next up would be the "Hyena" prospect in Wilmington Canyon Block 372 about 25 kilometers to the northeast, a late growth pinnacle reef on the shelf margin with development in the Jurassic and Lower Cretaceous sections.
- Last up would be the "Eland" prospect in Baltimore Rise Block 93, located about 55 kilometers to the southwest.

Planning for these wells involved a tremendous amount of cooperation and discussion between Shell and Amoco – not just on the G&G side but also on the engineering side. Nearly all of this work was done in the New Orleans offices of the respective companies.

Shell's engineers very quickly realized that because at least two of these wells would be world water depth records, a new deepwater riser and subsea completion system would be needed in order to maintain control of the large amount of drill string suspended from the drillship. And not just any drillship could handle the anticipated water depths; a state-of-the-art dynamically positioned ship was required.

Shell contracted Sonat's (now Transocean) Discoverer Seven Seas for the task, and working with Sonat's engineers and Hughes Offshore the new riser plus an extension to the Seven Seas existing riser system was fabricated and accompanying modifications were made to the Seven Seas. Total cost for the riser and ship modifications exceeded $21.5 million ($50.6 million in 2014 equivalent dollars) and took nearly two years to complete.

During 1982 Amoco's Mid-Atlantic team was moved from the Amoco building across Poydras Street and down the block to the newly completed Exxon building to get us away from curious colleagues. Management presentations therefore required frequent jaunts by George and me across Poydras to the Amoco building, our arms full of maps, seismic and presentation panels.

This was a somewhat dangerous exercise in those days, and following one high-level presentation a senior manager exclaimed: "Hey, what if Erlich gets hit by a bus while crossing Poydras? What will we do then?"

Although it was flattering to consider myself indispensable, it was also more than a little concerning that management's first thought was of the project and not the people.

The net result was the assignment of two additional G&G teams, which in retrospect was a prudent decision.

Wake Up!

Presentations to Amoco's Chicago management began in earnest in New Orleans in 1982, and continued into 1983 in advance of the drilling of the Civet well.

Our first big presentation was to be a morning review of the entire East Coast OCS, a presentation of several hours to John Meeker, then executive Vice President of E&P. I decided to arrive at the Amoco building early, as I couldn't afford to be late if we wanted continued support from Chicago for the program.

I caught the first elevator up, and riding up with me was someone I didn't recognize, whom I assumed was the man himself.

He introduced himself as "John," and in all our meetings continued to insist I call him by his first name. This was highly unusual for the times, especially considering Amoco's internal culture, which was frequently formal to the extreme.

John's other habit, one that often agitated his New Orleans subordinates, was to arrive in town unannounced and walk around the technical team floors, talking with the G&G staff and getting his own sense for how people were doing.

This practice was greatly appreciated by the staff, which saw him as a "normal guy," but local New Orleans management, more than a little concerned when he did that, would frantically search the Amoco and Exxon buildings until they found him.

On one such occasion I was working on some seismic lines when I saw John walk into my co-worker (and AAPG member) Gary Hummel's office, which was directly across the hall from me. I think Gary realized the visit was not just from your average senior level geologist, but because he was on the floor working on a map he didn't immediately get up.

Meeker's response was to grab a colored pencil and get down on the floor to help Gary, which I found highly entertaining.

They seemed to be enjoying themselves but our local management was not amused, and eventually collected John and ushered him back to the Amoco building.

My first presentation to John was plenty eventful but not nearly as enjoyable. On that fateful day when we shared an elevator up to the management floor, I had no idea that the future of the program was in our hands. Concerns had been raised in Chicago (and rightly so) about the probability of success of our efforts, so John had come down to New Orleans to see the technical story for himself.

Sharing the elevator that morning, it occurred to me that he must have had a difficult flight, because he looked tired and said he needed a coffee.

We parted ways and he went off to meet New Orleans region Vice President Bill Grisham while I waited with my presentation materials outside the conference room.

Not long after eight o'clock we were asked to enter and set up as the management team was settling in, and I was told to start with the North Atlantic and work my way south. I started with the regional geologic overview and was about five minutes into the presentation when John began rubbing his eyes and face.

He stopped me and said, "I'm just not getting this. Maybe I need another cup of coffee to wake up. I just need to wake up."

At this point I blurted out a potentially fatal, career-ending statement that has followed me to this day. I replied:

"Well, maybe you better wake up then."

Not only was there dead silence in the room, it was so quiet you couldn't even hear anyone breathing. Bill Grisham, New Orleans region Vice President of exploration Tony Benson and my direct managers all stared at me like I'd gone completely mad and committed career suicide. As soon as I blurted out those words I figured that my career in the oil business would be short indeed.

Meeker looked at me hard and then said, "Well, you're right. I do need to wake up. Let me get another cup of coffee and let's get going."

There was an audible sigh in the room from the local management, and when John sat down he was focused, engaged and attentive. I promised myself I would never do that again, and we continued the presentation.

In the end, Meeker agreed with our recommendation that Amoco should continue in the play with our partners.

Into the Record Books

In early 1983 we began direct well planning with Shell on Civet. Our gross AFE for the well was $28.5 million ($67 million in 2014 equivalent dollars). We proposed to take a series of cores at the top of the Jurassic so we could have the data we

See **OCS**, next page

OCS
from previous page

needed to evaluate what we hoped would be our reservoir.

This plan was scratched immediately by the engineers with questions like, "What if we take a gas kick at the top of the reservoir?" and "What if there is cavernous porosity and we drop the drill string?"

The geologists acquiesced to safety considerations and to waiting until we'd drilled into the main carbonate section.

The discussion then turned to who would sit the well for Amoco. With the thought that we might indeed take a kick at the top of the Jurassic the engineers also told us that they could not suppress more than 16 lb/gallon of pressure because it would be too heavy for the riser system. This was an unsettling prospect, and I decided not to volunteer for operations duty.

Shell finally spud the Civet well on Aug. 2, 1983, in Block 587 at a water depth of 1,965 meters (6,448 feet), then a world record for an exploration well. The drilling proceeded cautiously but efficiently and tagged the top of the Jurassic reef complex very close to the predicted depth. I received daily reports from Shell and was told to communicate only to Tony Benson on the well status.

As we crossed into the carbonates our worst fears were realized; there were no shows in the proposed reservoir section. Indeed, Civet was completed on Dec. 21, 1983, as a dry hole with no shows. We cut conventional cores and later work showed that we had the geology right, but that was little consolation.

The Discoverer Seven Seas was then moved to Block 586 to drill Rhino. The well was spud on Dec. 30, 1983, in 1,779 meters (5,838 feet) of water. We now were really concerned that hydrocarbon charge was also a critical risk, but with a large down-to-the-basin (east) fault that cut the Lower Jurassic, we hoped to have at least some shows.

Meanwhile, the team also was working on the location for the Eland well, so Rob Hoar, Gary and I developed what we thought was a good concept for the structure. We knew we were out of the carbonate platform trend and that a major river system had breached the area in the Jurassic-Early Cretaceous.

Eland also was characterized by a large down-to-the-basin (east) listric normal fault; the top of the structure was marked by a very bright seismic amplitude we felt indicated hydrocarbon-bearing sand.

I presented the early version of this story to John Meeker to get his authorization to join Shell and Murphy in the well. In mid-sentence John suddenly stopped me and said, "Ok, ok, I get it. What you guys are really telling me is that this is just a big damn thing and you want to drill it."

I said, "Yes, sir, that's what we are telling you."

"Ok, then let's cut the crap. Approved."

As strange as this may sound, it's how the last deepwater well in the U.S. East Coast OCS was authorized by Amoco.

Later I received the sad news from Shell that Rhino had drilled the anticipated reservoir section and found only minor gas shows in some small Jurassic sandstone beds. The well was completed on May 22, 1984, as a dry hole with non-commercial shows, so that meant the next well, Hyena, would be the last well drilled on a carbonate prospect.

The Discoverer Seven Seas spud the Hyena well in Block 372 at another world water depth record of 2,119 meters (6,952 feet) on May 26, 1984. Again, the well was conventionally cored and showed that we correctly interpreted the feature as a late growth pinnacle reef on the shelf margin, but it, too, was dry and was quickly plugged and abandoned on July 9, 1984.

Eland was spud on July 14, 1984 in block 93 in a water depth of 1,528 meters (5,013 feet), with Murphy now present as the third partner. To the partnership's disappointment, the well drilled through tight sandstones and siltstones at the top of the feature and then penetrated mostly shales and siltstones to TD.

The well was completed and abandoned as a dry hole on my 30th birthday, Nov. 4, 1984.

The presentation to management was somber at best, with Rob taking the lead. I only observed on this one, as I had already been reassigned to another project.

Lessons Learned the Hard Way

So what did Shell, Amoco, Sun, Murphy and the rest of industry learn from all this?

- A total of 51 wells were drilled along the U.S. East Coast OCS (excluding the Straits of Florida) from 1978-84 – five COST wells and 46 industry exploration wells – and none of them were commercially successful.

However, the wells were drilled without incident and with no negative environmental consequences in an area regarded as extremely sensitive, and at a time of heightened public awareness.

- Any new exploration that might be conducted in the area would now be done with the utmost attention to environmental regulations and safety concerns, utilizing a solid exploration process, proper risking, analytical tools and technical peer reviews.
- The overly optimistic approach taken by the industry in those days was certainly tempered by lessons learned the hard way, which is likely the best thing we as an industry and I personally learned from this huge expense of resources.
- The industry utilizes a much more quantitative approach now, and for the most part balances risk, cost and reward in a more appropriate manner.

The most recent (2012) BOEM mean resource estimates for the U.S. Atlantic OCS region are 3.3 billion barrels of recoverable oil and 31.3 TCF of gas – possibly overly optimistic once again.

But even if this is the case, it doesn't mean the area has no remaining potential. On the contrary, if we are ever given another chance, I have some definite ideas.

Maybe more importantly, I know what not to do this time.

(Editor's note: A complete version of this story can be found in the online May EXPLORER.)

HGS–PESGB

13th Conference on African E&P

Africa: A World of Opportunities

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The Westin Houston, Memorial City, 945 Gessner Road, Houston, Texas

Call for Papers, Posters, Sponsors and Exhibitors

In twelve years this conference has become established as a leading technical E&P forum on Africa, with attendance that can exceed 400. Participants include operators, service companies, consultants, governments and academia. The two day program of talks, technical posters and vendors' exhibits will be held on September 9-10, 2014 in Houston, Texas.

The conference, which alternates annually between London and Houston, is organized by the Houston Geological Society (HGS) and Petroleum Exploration Society of Great Britain (PESGB). The HGS-PESGB African Conference covers all aspects of African E&P, with particular emphasis on new ideas for plays and prospects, the geology of the continent and its conjugate margins, and application of emerging technologies.

Abstracts (~200 words) should be submitted as soon as possible to the technical committee, Africa2014@hgs.org.

Currently, volunteers are being sought to be proactive Session Chairs and anyone interested should contact the Technical Committee as soon as possible.

Details of sponsorship opportunities and display booths are available from the HGS office. To become a sponsor or inquire about exhibit space, contact sandra@hgs.org

Registration will be available from April 2014and Early Bird benefits will apply for a few weeks.

Further details will appear in the HGS and PESGB bulletins and on their websites, www.hgs.org and www.pesgb.org.uk.

Conference Committee for 2014

Martin Cassidy (chair), Al Danforth, Ian Poyntz, Donna Davis and Sandra Babcock (HGS)
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ACE—Success on All Levels

BY VERN STEFANIC, EXPLORER Managing Editor

An outstanding and comprehensive technical program complemented by an extensive exhibits hall that boasted the latest in industry technology and professional services combined to make the recent 2014 AAPG Annual Convention and Exhibition one of the largest gatherings in AAPG history.

The 2014 ACE, held in early April at Houston's George R. Brown Convention Center, attracted 9,386 attendees, making it the largest AAPG gathering ever held in Houston and the third largest meeting in AAPG history. The only larger meetings were the 1981 convention in San Francisco (12,152) and the 1980 event in Denver (9,475).

The meeting's theme was "Ideas and Innovation: Fuel for the Energy Capital," which was explored by more than 800 oral and poster presentations.

ACE highlights included:

- AAPG President Lee Krystinik's address to the opening session, in which he discussed the global implications of the industry's "unconventional resources revolution," and AAPG's role in those developments.
- The latest installment of AAPG's Discovery Thinking forums – this year expanded to an all-day session as eight geoscientists discussed new reserves, unconventional resources, payoffs from persistence and the application of highly specialized technology.
- A new special forum, titled "Communicating Our Science," featuring a panel of high-profile experts who discussed what and how to communicate with the public and media about sensitive topics in energy and science.
- The presentation of AAPG honors and awards, including a stirring tribute to Ernest A. Mancini, a renowned educator and leading researcher in stratigraphy and petroleum geology of the Gulf of Mexico region, as he received the Sidney Powers Memorial Medal, AAPG's highest honor.
- Informative and compelling luncheon speeches by a variety of speakers covering a wide-range of subjects, including:
  - ✔ Kirk Johnson, Sant Director of the Smithsonian's National Museum of Natural, who spoke on "Evolution, Time, Tectonics, Asteroids, Climate and the Trajectory of Earth Science."
  - ✔ Susan Cunningham, senior vice president of the U.S. Gulf of Mexico, Africa and Frontier Region for Noble Energy, speaking on "Exploration and the Oil and Gas Industry: Having a Positive Impact on People and the World."
  - ✔ Scott Tinker, director of the Bureau of Economic Geology and state geologist of Texas, speaking on "The Future of U.S. Shale."
  - ✔ Anthony R. Fiorillo, with the Perot Museum of Nature and Science, speaking on "A Perspective from Dinosaurs on Climate Change."

The 2015 ACE will be held May 31-June 3 in Denver.

Kirk Johnson at the All-Convention Luncheon in Houston: "We live in a really unique time ... but unless we put it in context, we don't realize this is a really important time."

Vanguards of History: Energy Changes Everything

By BRIAN ERVIN, EXPLORER Assistant Managing Editor

The human race currently finds itself rounding the corner of an unprecedented turning point in history, and it's a direct consequence of what AAPG members do on a daily basis.

That was the gist of the presentation Kirk Johnson delivered at the All-Convention Luncheon at AAPG's recent Annual Convention and Exhibition, titled "Evolution, Time, Tectonics, Asteroids, Climate and the Trajectory of Earth Science."

As a 2007 AAPG Distinguished Lecturer, and as last year's winner of the AAPG Geosciences in the Media Award for a book he co-authored titled "Cruisin' the Fossil Freeway," Johnson likely is familiar to many AAPG members, even if they didn't attend the luncheon at ACE.

"We live in a really unique time," he said. "People will say, 'It's always been changing,' but the fact is, we're in a unique time in human history, and it's manifested by things we see all around us, but unless we put it in context, we don't realize this is a really important time."

Johnson is Sant Director of what is arguably the world's premiere science research and education institute – the Smithsonian's National Museum of Natural History in Washington, D.C. His background is in geology and paleontology.

As such, like many in his field, he's spent his career immersed in the study of that broader context.

"As a deep-time geologist who talks about billions of years and tens of millions of years," he commented, "when we're talking about something as short as a century – the last one or the next one – there are a lot of interesting conversations to be had."

A Unique Vantage Point

And, of course, his current post also gives him a unique vantage point for a long view of history.

"If you think about museums – they are these places that store stuff from the past, but one of the things that's happening very much in the museum industry these days is, museums are realizing they're really places to help people think about the future," he said.

Johnson explained that the recent past set a trajectory for a future beyond anything imagined by our most recent ancestors.

"I continue to be really amazed at how much has happened in the last century, which seems like a long time in one sense, but my grandfather was born in 1879 and I knew him, so it wasn't that long ago – and he was born only 20 years after the first oil well was drilled, and that means that so much of what we're talking about is really in a couple of generations," he added.

Ready examples of what he's talking about can be found any given week in almost any science magazine, he said. Or, there are examples closer at hand, but as commonplace elements of our daily lives, most people overlook them as the remarkable artifacts that they are of the spectacular changes of the last century.

"A lot of us have lived through them and have this sense that they've been around for a long time," he said, "but when you look back and go, 'Oh yeah – my iPhone.' iPhones didn't exist seven years ago."

> **"Museums are realizing they're really places to help people think about the future."**

Cheap Energy: Priceless

More amazing even than the advent of the iPhone, though, are the rapid advances in our understanding of human genetics.

"We just opened an exhibit at the museum called 'Genome,' which is about the sequencing of the human genome," said Johnson.

A mere decade ago, he noted, it cost about $2 billion to read the entire 3.2 billion base pairs of the human genome. Today, it can be done for a scant $1,000.

Most significantly, though, the explosive growth of the earth's population represents a dizzying transformation of human

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AAPG Annual Convention & Exhibition 2014

Playmaker Forum Heads to Calgary

The inaugural Canadian Playmaker Forum will be held May 27 at the Martha Cohen Theatre in Calgary, Canada.

The event is organized by the Canadian Society of Petroleum Geologists, AAPG and the AAPG Division of Professional Affairs, and produced by Geoscientists for Geoscientists.

The Forum brings well-known, successful and distinguished Canadian industry leaders together for a day of unparalleled discussion on a cross-section of elements, including geoscience, engineering, strategy and business skills necessary to successfully mature prospects from first insight through play entry, marketing and discovery.

The event is an outgrowth of the successful and highly popular Playmaker Forum began two year's ago by the DPA and held in Houston.

The inaugural Canadian Playmaker Forum will begin at 8 a.m. and conclude with a reception from 5:30-7 p.m.

The keynote speaker will be AAPG member Clay Riddell, CEO of Paramount Resources.

Its four sessions will cover:

- The Art of Exploration and Professionalism.
- Understanding and Promoting Prospects.
- Recent Discoveries – Case Histories and Learnings.
- Emerging Plays and Technology Advancements.

Johnson

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civilization: Until about 1800, earth's population had never exceeded one billion people, but in 200 years it swelled to seven billion, and it's expected to reach nine billion by 2050, and then level out.

"The worldwide population has doubled since I was born," Johnson said. "Little facts like those, when we put it all together in context, opens up a lot of questions around what's coming up next.

"There are so many things that are happening now that if you mash them all together, the potential for technology and science to help us figure out the planet and to figure out the next century is just fantastic," he said.

And, it was all made possible by the industry represented by AAPG.

"We're here because the supply of cheap energy has allowed us to grow an industrialized civilization over the last 100 years," he noted. "I mean, it wasn't like that for the thousands of years that preceded it."

The energy industry and its members, he said, have been positive agents for humanity's virtually sudden transformation into an industrialized, technological civilization, and Johnson's message is that they can and should continue to be.

"We're at a point," he said, "where we have the ability to understand things scientifically and to make really smart choices for the future."

Keep An Open Mind

Given the dizzying changes civilization has undergone in the past century, he said it's imperative that industry decision-makers keep open minds for even more seismic shifts in the not-too-distant future.

His consistent message to the oil and gas industry, he said, is to think well beyond the usual five- or 10-year timeline, and to make plans on a 50- or 100-year scale.

"The implication there is that our views are going to continue to change as we add new technology and make new discoveries," he said. "And that's kind of the thing: We tend to look back and go, 'That was a discovery that was made and it wasn't that interesting,' but as we look forward over the next 10 years we know we're going to have a discovery of that order of magnitude," he said.

Of course, we can't know for sure what most of those changes will be or how our knowledge base will expand – but there are some reasonable predictions we can make about the broad strokes.

"We do know a couple of things that are sort of baked-in," Johnson said. "Unless there's some vast pandemic or something, all things being equal, we'll grow our population another two billion, which is going to create that much more demand on the earth's system and that many more economic opportunities and that many more brilliant minds to solve problems, and then it will kind of flatten out there," he continued.

Another practical certainty, Johnson said, is the carbon accumulation in the atmosphere.

"We don't really know, yet, how the actual impacts will be, but it is causing warming now and acidification of the oceans, so there's that piece of the puzzle: the amount of carbon we burn to-date is in the atmosphere right now, less what's been drawn out by the oceans and the plants," he said.

Also, there's the direct impact of humans on the landscape through agriculture and urbanization to consider.

"You've got a fixed and growing load on the planet right now, so the question, really, as we look into the next century is this challenge we have – the wants and needs of humans on one side – we have the advantages and opportunities of technology, and we have the health of the planet and the natural ecosystems," he said.

"I'm just trying to get people to think about these things, and the oil and gas industry is a really good audience because they have been active agents of our destiny," he said.

"If you think about what oil and gas has done to improve the economy and to drive the population in this country and provide cheap energy, it's an organization that's rightly proud of its legacy," he said, "and the challenge to them is to continue to think about the future and how the industry is going to be a force for good in the future."

Historical Highlights is an ongoing EXPLORER series that celebrates the "eureka" moments of petroleum geology, the rise of key concepts, the discoveries that made a difference, the perseverance and ingenuity of our colleagues – and/or their luck! – through stories that emphasize the anecdotes, the good yarns and the human interest side of our E&P profession. If you have such a story – and who doesn't? – and you'd like to share it with your fellow AAPG members, contact Hans Krause at historical.highlights@yahoo.com.

Remembering a Rich History at Turner Valley

By CLINTON TIPPETT and DAVID FINCH


TIPPET


FINCH

May 14, 2014, marks the 100th anniversary of the initial petroleum discovery at Turner Valley. The field sits at the leading edge of the Foothills Belt of the Rocky Mountains, just to the southwest of Calgary, Canada.

The field's relatively simple structure features a massive thrust sheet carrying Mississippian carbonates at its base. The overlying Mesozoic section, deformed into a broad anticline, forms the crest of the Triangle Zone at this latitude and is related to the cut-out of the carbonates above the sole fault.

Understanding of the subsurface was incomplete during much of the life of the field and multiple visualizations of its geometry were proposed.

It was only after modern seismic techniques were brought to bear to complement the extensive drilling record that the true nature of the structure became apparent.

Turner Valley was not western Canada's first discovery:

- Natural gas had been found at Langevin Siding in southeast Alberta in 1883, by railroad workers seeking water for their steam engines.
- The first decade of the 20th century had seen a flurry of activity in what is now Waterton National Park, adjacent to Glacier National Park, in fractured Precambrian clastics carried in the overthrust belt.

The combination of these small discoveries and the widespread feeling that having local oil discoveries was the key to prosperity set the stage for the excitement at Turner Valley.

In the Beginning

Early exploration at Turner Valley was triggered by surface seeps of natural gas – and by an understanding of the anticlinal theory of hydrocarbon accumulation.

W.S. "Stewart" Herron, a local rancher who had gained some experience in the Pennsylvania oilfields prior to coming west, recognized the opportunity for a local strike and had validated the deep source of the gas by sending samples to labs in California and Pennsylvania.

Herron proceeded to accumulate a sizeable land base. He promoted the opportunity to local businessmen who formed a company called Calgary Petroleum Products Limited to fund the drilling of a test well that was spudded on Jan. 25, 1913.

The rig was a California-type cable tool outfit rigged with an 85-foot wooden derrick. The boiler was coal-fired when the well spudded, but gas-fired after the first gas flow was encountered at a depth of 180 feet.

The consortium included businessman and driller A.W. Dingman, after whom these early wells are commonly named. Dingman, originally from Prince Edward Island, also had gained some field experience in Pennsylvania.

Speculation erupted following every show of oil or gas encountered in the wellbore, and speculators had a heyday. It is said that more than 500 new oil companies were formed during this exciting period.

Local humorist Bob Edwards quipped in his "Calgary Eye Opener" column, "The trouble with this oil situation at this formative stage is that you are never sure whether the man you meet on the street is a multi-millionaire, or just an ordinary, common millionaire."

'Hell's Half Acre'

The discovery well, Calgary Petroleum Products No. 1, finally came in on May 14, 1914, at 4 mmcf/d of wet natural gas at a depth of 2,717 feet in the sandstones of the Lower Cretaceous section.

A small absorption plant was built to extract the natural gas liquids.

Unfortunately production did not live up to expectations, and development of the discovery was slow and hampered by the onset of World War I, which restricted the availability of capital.

And as to the speculation, it was written by Canadian petroleum historian Earle Gray:

"Within a few months Calgarians woke up from that monumental speculative spree with such a hangover that more than a half a century later the city still remembered the event as the wildest boom that ever hit the west.

"More than 500 companies had been formed within a few months, holding half a million acres of oil leases and with authorized capital totalling an estimated $400 million. Less than 50 companies actually started drilling, and few of those found any oil.

"Calgarians, wiped clean of more than a million dollars of savings, were left holding thousands of share certificates worth less than wallpaper. Several homes, and the lobby of one hotel, were actually wallpapered with share certificates."

On Oct. 14, 1924, Royalite No. 4, drilled by a subsidiary of Imperial Oil that had taken over CPPL's operations following a fire in 1921, deepened a northern step-out well into the underlying Paleozoic section and intersected the deep natural gas accumulation hosted in the Mississippian strata in the up-dip part of thrust sheet.

The well blew out and is estimated to have flowed at over 20 mmcf/d with 500-600 bbl/d of condensate. This pool is now recognized as having had 1.5 TCF OGIP.

Its pursuit occupied the industry from 1924 through to 1936. Exploitation primarily involved production of the natural gas for its condensate content. Sales of the residual gas were made when possible, but significant volumes often were flared when production exceeded demand – and gave the name "Hell's Half Acre" to the gully in which this incineration was continually in progress.

Almost 160 bcf or over 400 mmcf/d of gas was flared in 1931.

Later Developments

The next chapter of the field's life was ushered in by the testing on June 16, 1936, of Turner Valley Royalties No. 1, a downdip crude oil discovery in the Mississippian that came in at 850 bbl/d of 39-degree crude oil.

This deeper flank pool had one billion barrels OOIP and 1.36 TCF of solution gas, but recoverable oil volumes of only 156 mmbbl, due to the depressuring of the field during aggressive production of the associated gas cap.

A significant northern step-out in 1938 into the Millarville segment virtually doubled the strike length of the field. Oil production peaked at about 27,000 bbl/d in 1942, at which point the field was providing approximately 97 percent of Canada's domestic production.

The intense development activity led to an influx of workers who established towns known as Little New York (now Longview) and Little Chicago (officially called Royalties, but now gone and only acknowledged with a small cairn).

Turner Valley has continued to attract industry attention even in the waning years of its primary pools:

- Unitizations accompanied by major water flood schemes were instituted in the late 1950s.

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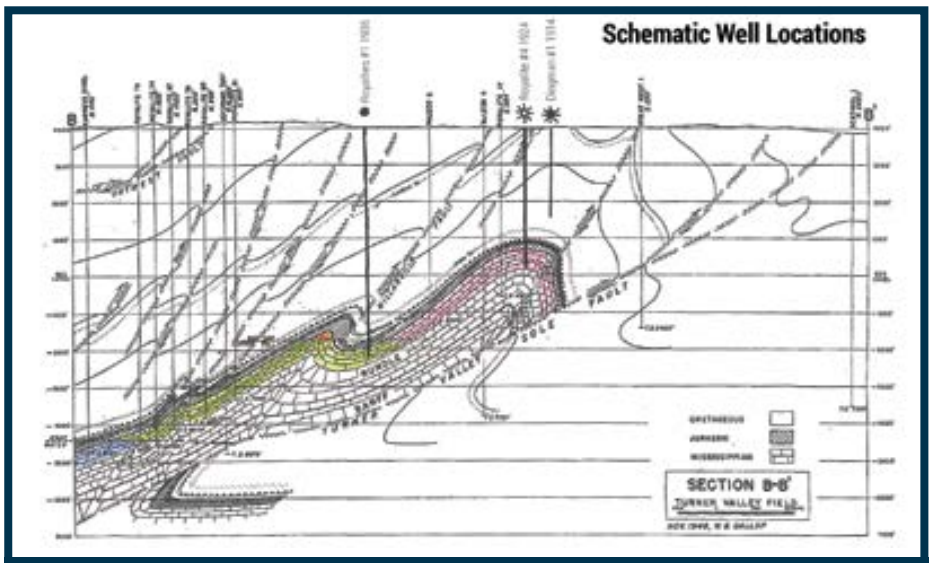

Above: Cross-section and schematic well locations for the Turner Field, November 1948.

Below: Oil wells at Turner Valley, Canada 1940, drilled by Home Oil, Mayland, Calmont, Lowry, Northwest Associated and Alberta Pacific Consolidated.

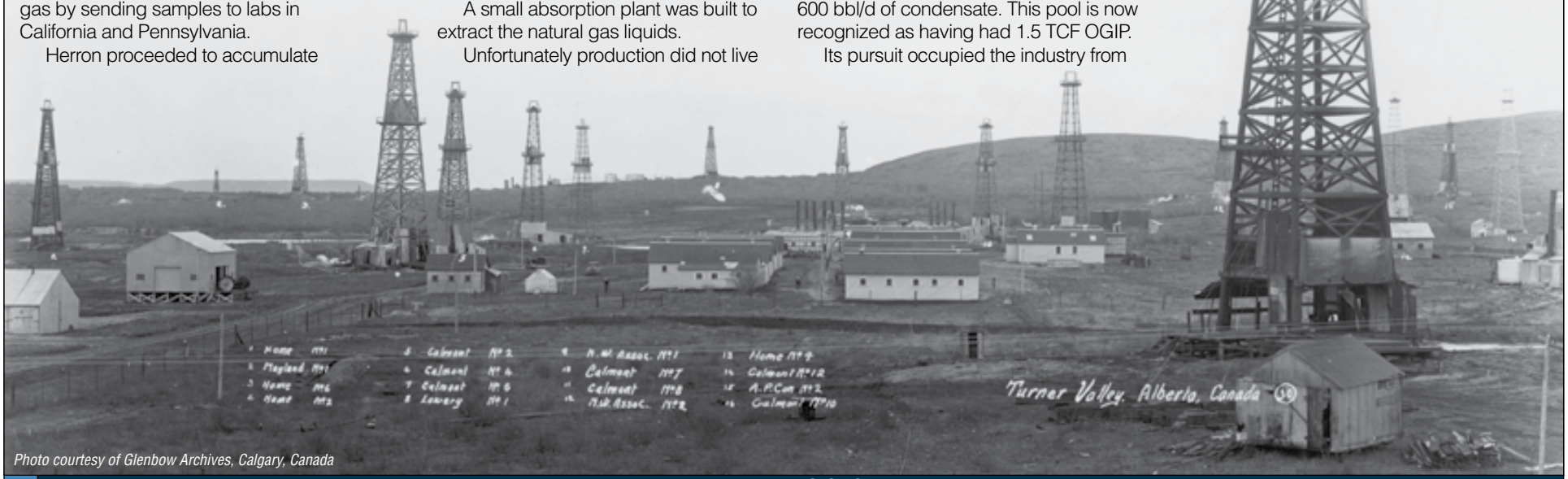

Photo courtesy of Glenbow Archives, Calgary, Canada

Turner Valley

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- Improved seismic resolution led to the identification of several additional hitherto untapped thrust imbricates in the field.
- There was a period of renewed interest in the Cretaceous section.
- More recently, the applications of horizontal wells and tertiary recovery processes have led to a modest revival of production, to about 7,000 bbl/d.

It is interesting to note the connection between the work of American geologists and Turner Valley. Early stratigraphic nomenclature was imported from south of the border, including:

- The Benton Shale, or Colorado Group (now Alberta Group), for the Late Cretaceous shale package.
- The Dakota and Kootenai formations (now Mannville and Blairmore groups) for the Early Cretaceous clastic-dominated section.
- The Madison Group (now Rundle Group, including the Turner Valley Formation) for the upper part of the Mississippian section.

A Historical Setting

The history of Turner Valley is rich in cultural and technological detail. Although relatively small by global standards, it brought significant economic activity, employment and financial rewards to individuals, companies and governments.

The field also was important in other ways because of the timing of its life relative to global events.

First, its exploration and production occurred in part during the Great Depression, and therefore brought much needed relief to southern Alberta.

Then during World War II, crude oil production from Turner Valley was critical in the establishment and capacity of the British Commonwealth Air Training Program that was vital to the Allied war efforts.

Finally, as the home of the first full-scale commercial petroleum production facilities in Alberta, it positioned both the industry and the government for the rapid pursuit, beginning in 1947, of Leduc and other world-class discoveries in the Western Canada Sedimentary Basin.

Human, physical and capital resources were quickly redeployed from Turner Valley in the declining years of its life. Likewise, Alberta's regulatory regime for the industry became firmly established in 1938 in recognition of the fact that conservation measures were required to combat wasteful approaches, so as to achieve optimal recovery efficiencies of subsurface resources – a need reinforced by the 1936 crude oil discovery.

Turner Valley was the early stomping ground for many individuals who went on to greater fame later in life:

- **Ted Link**, who was AAPG president 1956-57, was chief geologist for imperial Oil and published a synthesis on the field, together with P.D. Moore, in the AAPG BULLETIN in 1934. Link also was instrumental in the Imperial Oil discoveries at Norman Wells (1920) and Leduc (1947).
- **Stanley Slipper**, who was one of the first geologists to study the field, became the first president of the Alberta (now Canadian) Society of Petroleum Geologists in 1927, in the aftermath of the activity generated by the 1924 natural gas discovery.
- **R.B. Bennett**, one of the investors in CPPL, became prime minister of Canada between 1930 and 1935.

But it also is important to examine Turner Valley in its broader societal context as well; in 1912 there was so little petroleum in western Canada that the city of Calgary could not afford to purchase oil to keep down the dust on its streets. As a result, the 1914 discovery of the first commercial accumulation in the West bearing liquid hydrocarbons changed Alberta forever.

What's in store for Turner Valley?

Is the field played out?

Probably not.

And there are still some significant technical puzzles. For example, why does Turner Valley contain the only significant crude oil accumulation in the Foothills Belt in this region?

Might a story about charge, retention and leakage lead the way to additional, as yet undiscovered pools?

Only time will tell.

Photo courtesy of the Glenbow Archives, Calgary, Canada, and taken by Harry Pollard

Men in cars and on sidewalk waiting to invest in oil stocks, Calgary, Canada, 1914. Photo taken in front of the temporary offices of Fidelity Oil and Gas Company in the Palace Rooms (formerly Palace Hotel) located on the corner of 9th Avenue and Centre Street S.W.

*Editor's note: AAPG member **Clinton Tippett** is a petroleum geologist who recently retired from Shell Canada, where he worked as project coordinator in the Central Mackenzie Valley, Northwest Territories. He has a Bachelor of Science and a Master of Science from Carleton University in Ottawa, Canada, and a doctorate from Queen's University in Kingston, Canada. He is president of the Petroleum History Society and chair of the C.S.P.G. History and Archives Committee.*

***David Finch** is a public historian and holds the Master of Arts in Post-Confederation History from the University of Calgary. He is the author of more than 20 books on the history of the Canadian West, including several on the oil industry including "Hell's Half Acre: Early Days in the Great Alberta Oil Patch."*

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UNDERSTANDING UNCONVENTIONAL CARDIUM TARGETS (E&P Note)

Andrew C. Wiseman and Federico F. Krause

Reservoir quality, net-pay, and completion techniques are compared to production data to evaluate the successes and failures of completion strategies and geological characterizations for the unconventional portions of the Cardium Formation, Pembina Field, Alberta.

BEWILDERING SANDSTONE BODIES

Christopher R. Fielding, Andrew J. Hutsky, and Trevor J. Hurd

Conventional sequence stratigraphy does not readily account for systems tracts such as the Peay Sandstone. Recognition of deltas and other shallow marine sandstone bodies formed under variable, low-accommodation conditions may help to resolve the origin of these isolated bodies.

SOUR NATURAL GAS

Lei Jiang, Richard H. Worden, and Chun Fang Cai

Thermochemical sulfate reduction in the Feixianguan Formation, China, leads to anhydrite dissolution and calcite replacement, petroleum destruction, bitumen and elemental sulfur formation, and the generation of H_2S from oil-anhydrite and gas-anhydrite reactions.

FLUID FLOW PROPERTIES OF THE SHALE MATRIX

Rob Heller, John Vermylen, and Mark Zoback

Laboratory experiments show that the matrix permeability of gas shales is more sensitive to changes in confining pressure than changes in pore pressure. The effective permeability of the rock is also significantly enhanced at very low pore pressures due to slippage effects.

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AAPG BULLETIN

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The Geophysical Corner is a regular column in the EXPLORER, edited by Satinder Chopra, chief geophysicist for Arcis Seismic Solutions, Calgary, Canada, and a past AAPG-SEG Joint Distinguished Lecturer. This month's column deals with post stack spectral balancing and spectral bluing.

Am I Blue? Finding the Right (Spectral) Balance

By KURT J. MARFURT and MARCILIO C. de MATOS

Seismic interpreters have always desired to extract as much vertical resolution from their data as possible – and that desire has only increased with the need to accurately land horizontal wells within target lithologies that fall at or below the limits of seismic resolution.


MARFURT

Although we often think of increasing the higher frequencies, resolution should be measured in the number of octaves, whereby halving the lowest frequency measured doubles the resolution.


MATOS

There are several reasons why seismic data are band-limited.

First, if a vibrator sweep ranges between 8 and 120 Hz, the only "signal" outside of this range is in difficult to process (and usually undesirable) harmonics.

Dynamite and airgun sources may have higher frequencies, but conversion of elastic to heat energy (intrinsic attenuation), scattering from rugose surfaces and thin bed reverberations (geometric attenuation) attenuate the higher frequency signal to a level where they fall below the noise threshold. Geophone and source arrays attenuate short wavelength events where individual array elements experience different statics. Processing also attenuates frequencies. Processors often need to filter out the lowest frequencies to attenuate ground roll and ocean swell noise. Small errors in statics and velocities result in misaligned traces that when stacked preserve the lower frequencies but attenuate the higher frequencies.

* * *

Currently there are two approaches to spectral enhancement.

More modern innovations that have been given names such as "bandwidth extension," "spectral broadening" and "spectral enhancement," are based on a model similar to deconvolution, which assumes the earth is composed of discrete, piecewise constant impedance layers. Such a "sparse spike" assumption allows one to replace a wavelet with a spike, which is then replaced with a broader band wavelet that often exceeds the bandwidth of the seismic source.

Model-based processing is common to reflection seismology and often provides excellent results – however, the legitimacy of the model needs to be validated, such as tying the broader band product to a well not used in the processing workflow.

We have found bandwidth extension algorithms to work well in lithified Paleozoic shale resource plays and carbonate reservoirs.

In contrast, bandwidth extension can work poorly in Tertiary Basins where the reflectivity sequence is not sparse, but rather represented by upward fining and coarsening patterns.

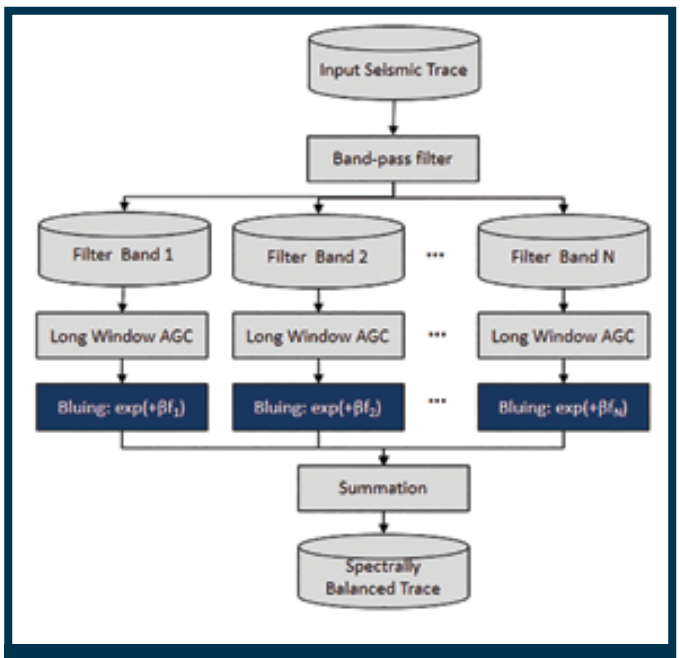

Figure 1 – Traditional spectral balancing (in gray), which is usually applied trace by trace. The concept of bluing (in black) is a more recent innovation that is simply inserted inside the workflow.

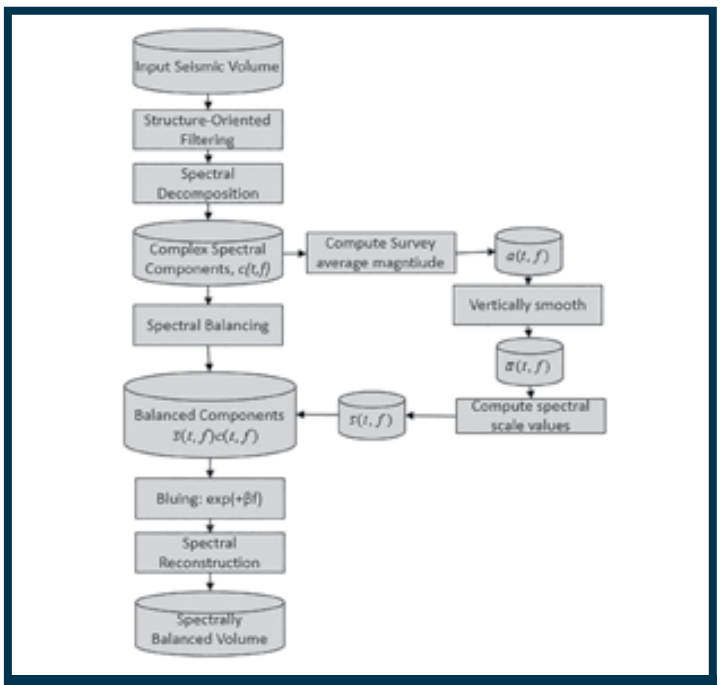

Figure 2 – A more modern volume based spectral balancing workflow that uses structure-oriented filtering and spectral decomposition components.

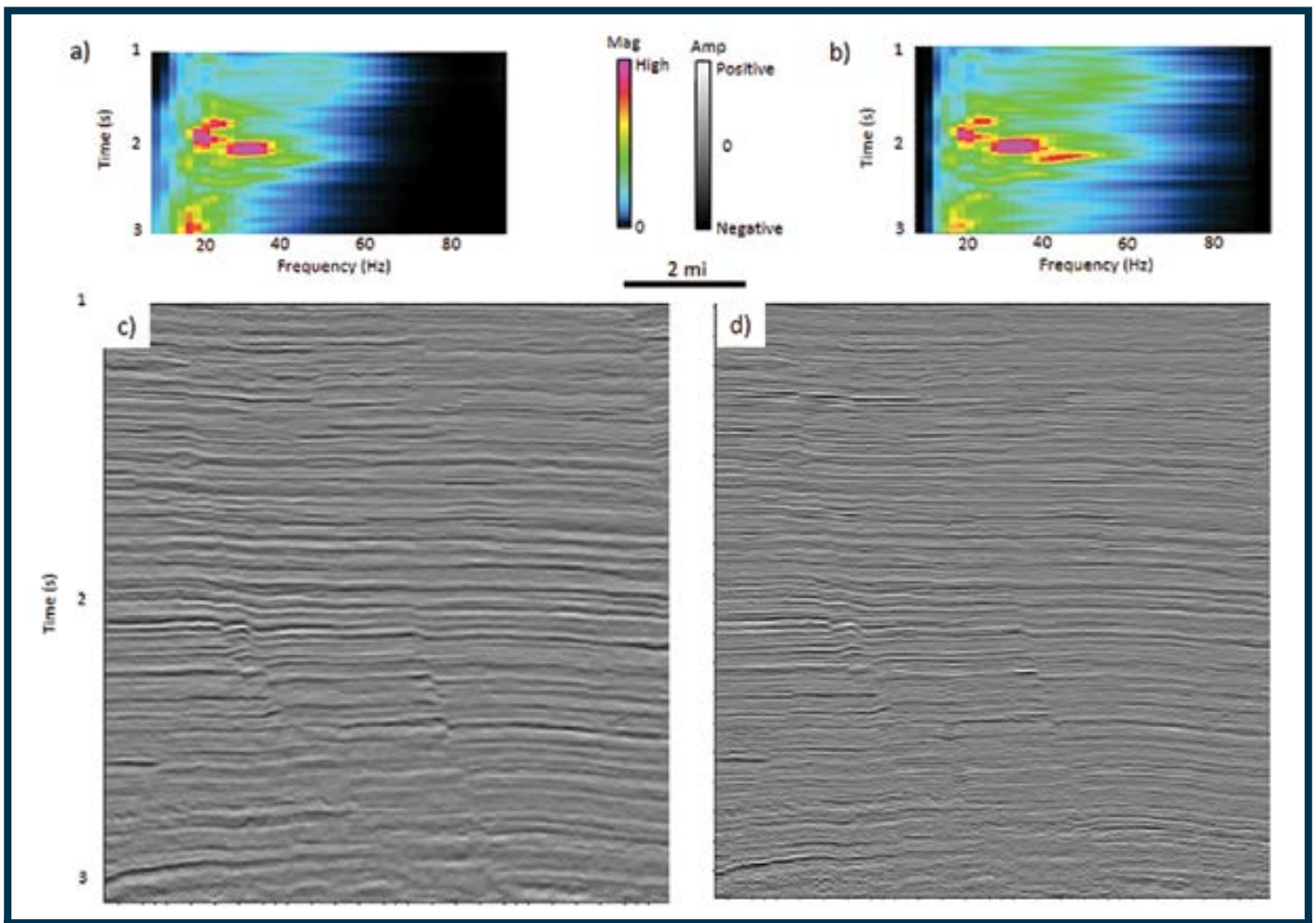

Figure 3 – Average time-frequency spectra of a legacy ocean-bottom cable data volume (a) before and (b) after applying the spectral balancing and bluing workflow shown in figure 2. Bluing factor β=0.3 and smoothing window = 0.5 s. Representative vertical slices through the seismic data (c) before and (d) after spectral balancing and bluing. The actual spectra of these slices are different from the average spectra.

In this article, we review the more classical workflow of spectral balancing, constrained to fall within the source bandwidth of the data.

Spectral balancing was introduced early in digital processing during the 1970s and is now relatively common in the workstation environment.

* * *

As summarized in figure 1, the interpreter decomposes each seismic trace into a suite of 5-10 overlapping pass band filtered copies of the data. Each band-passed filtered version of the trace is then scaled such that the energy within a long (e.g. 1,000 ms) window is similar down the trace.

This latter process is called automatic gain control, or AGC.

Once all the components are scaled to the same target value they are then added back together, providing a spectrally balanced output.

A more recent innovation introduced about 10 years ago is to add "bluing" to the output. In this latter case, one stretches the well logs to time, generates the reflectivity sequence from the sonic and density log and then computes its spectrum. Statistically, such spectra are rarely "white," with the same values at 10 Hz and 100 Hz, but rather "blue," with larger magnitude spectral components at higher (bluer) frequencies than at lower (redder) frequencies.

The objective in spectrally balancing then is to modify the seismic trace

Continued on next page

Continued from previous page

spectrum so that it approximates the well log reflectivity spectrum within the measured seismic bandwidth.

Such balancing is achieved by simply multiply each band-pass filtered and AGC'd component by exp(+βf), where f is the center frequency of the filter and β is the parameter that is obtained from the well logs that varies between 0.0 and 0.5 (black boxes in figure 1).

There are several limitations to this classic workflow:

- First, one balances the measured seismic data, which is the sum of the signal plus noise. Ideally, we want to balance the signal.
- Second, since the filters are applied trace by trace, the process as a whole is not amplitude friendly and inappropriate as input to more quantitative amplitude-sensitive analysis such as AVO and post-stack or prestack inversion.
- Third, if the AGC window is too small or the statistics of the reflectivity sequence insufficiently smooth (an end member example would be coal bed cyclothems and sabkha sequencies), then reflectors of interest can be suppressed and artifacts created.

A fairly common means of estimating the spectrum of the signal is to cross-correlate adjacent traces to differentiate that part of the signal that is consistent (signal) and that part that is inconsistent (random noise). One then designs the spectral balancing parameters (AGC coefficients) on the consistent part of the data.

Unfortunately, this approach is still not amplitude friendly and can remove geology if the spectra are not smooth.

* * *

Figure 2 illustrates a more modern approach that can be applied to both post-stack and prestack migrated data volumes.

First, we suppress crosscutting noise using a structure-oriented filtering algorithm, leaving mostly signal in the data.

Next, the data are decomposed into time-frequency spectral components.

Finally, we compute a smoothed average spectrum.

If the survey has sufficient geologic variability within the smoothing window (i.e. no perfect "railroad tracks"), this spectrum will represent the time-varying source wavelet.

This single average spectrum is used to design a single time-varying spectral scaling factor that is applied to each and every trace. Geologic tuning features and amplitudes are thus preserved.

We apply this workflow to a legacy volume acquired in the Gulf of Mexico:

- Figures 3a and b show the average spectrum before and after spectral balancing.
- Figures 3c and d show a representative segment of the seismic data where we see the vertical resolution has been enhanced.

(Editor's note: AAPG member Kurt J. Marfurt is with the University of Oklahoma; Marcilio C. de Matos is with Sismo Research, Rio de Janeiro, Brazil, and the AASPI Consortium research program at the University of Oklahoma.)

Edith Allison, director of AAPG's Geoscience and Energy Office in Washington, D.C., can be contacted at eallison@aapg.org; or by telephone at 1-202-643-6533.

Making Connections During the Annual CVD

By EDITH ALLISON, Geoscience and Energy Office Director

As part of our spring – or almost spring – Congressional Visits Days (CVD) on March 10-12, AAPG members visited agency and congressional offices, advocating for geoscience research and science-based regulation, learning about the activities and opinions of decision makers, and establishing contacts for future communication.

Our only complaint was that so few AAPG members were able to join us.

This year our group of 11 – together or as smaller groups – met with six executive branch agencies plus 16 senators' or representatives' offices.

The fact that Congress set aside last year's budget sequester (across-the-board cuts) and approved a federal spending bill in January may have been the source of this year's more forward-looking discussions with both executive branch agencies and congressional offices.

It also is likely that recurring visits with AAPG members over the past several years are leading to more informed and forward-looking discussions.

Many of the groups that we met included well-informed, high-level managers – a sign of how much they value our visits. These meetings also provided information on new programs or initiatives, which may be useful to members who are reading this article.

(If you wish additional information or instructions on how to provide input to government decision makers contact Edith Allison at eallison@aapg.org, or 202-643-6533.)

AAPG's CVD team: (top row, from left) Art Johnson, Roger Humphreville and Don Juckett; (middle row) Dan Billman, Edith Allison, Paul Britt and Richard Ball; (bottom row) Jim Hill, Carol Hill, (guest) Shawn Woodbridge, Valary Schulz, Pete Mackenzie and Connie Mongold.

* * *

During the meetings, AAPG members stressed that they and their colleagues are available as a source of accurate, unbiased scientific information about petroleum and environmental geoscience.

Many of the groups that we met asked for our input and coordination on issues of common interest, for example:

- The Bureau of Safety and Environmental Enforcement (BSEE) and the Bureau of Ocean Energy Management (BOEM) are charged with managing offshore energy activities. During our discussions the agencies described their difficulties in recruiting geologists, geophysicists and engineers, which is made more difficult by the high demand by industry for these same professions and higher industry salaries.

AAPG members provided the appropriate AAPG contacts for two AAPG opportunities: Student expos and the Imperial Barrel Award competition.

See **Policy**, page 50

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Complex Carbonate Reservoirs	September 20-26, 2014 Italy
Folding, Thrusting and Syntectonic Sedimentation: Perspectives from Classic Localities of the central Pyrenees	September 22-26, 2014 Spain
Unconventional Petroleum Systems Field Trip (with SEG meeting)	October 25-26, 2014 Colorado

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Fractured Reservoirs: From Geologic Concepts to Reservoir Models (course plus field trip)	September 8-12, 2014 Casper, WY
Practical Salt Tectonics	December 8-11, 2014 Houston, TX

www.aapg.org/career/training/

AAPG Education

AAPG Secretary Richard Ball, part of the CVD team, archives the experience.

Policy
from page 48

▸ BSEE wants to hear from companies that wish to be involved in the new Ocean Energy Safety Institute (OEIS), managed by the Texas A&M Engineering Experiment Station, to enhance communication and coordination for offshore safety.

OEIS is planning several forums this spring to encourage industry, academia and industry collaboration and communication.

▸ BOEM officials stated their plans to ask the AAPG Committee on Resource Evaluation to peer review the 2016 update of OCS technically recoverable resources. This AAPG committee has assisted U.S. government agencies for many years by peer-reviewing assessments.

Another opportunity for AAPG members, and other stakeholders: We will be invited to contribute to the BOEM 2017-21 five-year plan starting with the "Request for Information" later this year.

▸ Our group met with senior managers of the EPA Office of Atmospheric Programs, which is responsible for climate change activities and greenhouse gas (GHG) emissions.

This was AAPG's first meeting with EPA offices that are responsible for monitoring and regulating oil and gas industry air emissions.

The EPA managers seemed unfamiliar with the upstream oil and gas industry, which is not unexpected given that most emission reporting is done by downstream operations.

EPA invited comments on the latest GHG emissions report and planned changes in the reporting rules. Pete Mackenzie offered to provide information from recent studies documenting emissions.

A couple weeks after our meeting the White House announced its Climate Action Plan, which directs EPA to solicit expert input on methane emissions from oil and gas operations as a basis for deciding on the need to regulate industry methane emissions. In mid-April, EPA will release five white papers on potentially significant sources of methane and VOC emissions from the oil and gas sector nationwide:

✓ Hydraulically fractured oil wells.
✓ Liquids unloading.
✓ Leaks.
✓ Pneumatic devices.
✓ Compressors.

EPA will be accepting public comments. AAPG's energy and geoscience policy office will publicize the white papers with instructions on how to respond.

The EPA contacts established during the CVD meetings will help AAPG members to be involved in the discussions about industry methane emissions, which could have a significant impact on industry operations and the cost of energy to consumers.

▸ The AAPG group divided in two in order to visit both the majority and minority staff of the House Natural Resources Committee, one of three House committees involved in energy policy and regulation.

(The other relevant House committees are Energy and Commerce, and Science, Space and Technology.)

Both majority and minority staff include scientists and are knowledgeable in industry issues. The majority staff asked AAPG members to let them know about industry activities and issues that might precede congressional involvement.

▸ Meetings with individual Senate or House members were a mix of new introductions and renewed acquaintances. Several DPA members have participated in several CVDs and the annual September Geo-CVDs. Recurring meetings with congressional staff build a strong foundation for them to seek AAPG members' opinions.

Congress does the majority of its work through committees and their subcommittees. Committees conduct hearings and develop legislation under Congress' responsibilities to legislate and oversee the executive branch.

The House has 23 committees and 104 subcommittees; the Senate has 17 committees and 70 subcommittees. The senators and representatives that our members met are members of the committees most influential in oil and natural gas science, research and regulation – for example, Senators Barbara Boxer (D-Calif.) and David Vitter (R-La.) are the chair and ranking member of the Environmental and Public Works Committee that oversees the EPA.

AAPG members at CVD also met with representatives on two of the major House energy and science committees: Energy and Commerce, and Science, Space and Technology.

With a larger group, we could have an opportunity to establish communication with a representative on the Natural Resources Committee.

* * *

Another opportunity to visit Congress with a group of AAPG members is Geoscience Congressional Visits Day on Sept. 17-18. More information is available at the American Geosciences Institute website.

AAPG | Imperial Barrel Award 2014

A Joint Program of AAPG and the AAPG Foundation

CONGRATULATIONS TO THE 2014 IMPERIAL BARREL AWARD WINNERS

The University of Louisiana at Lafayette, representing the Gulf Coast Section, took home the top prize in this year's AAPG/AAPG Foundation's Imperial Barrel Award competition.

The University of Oklahoma, representing the Mid-Continent Section, finished second.

The Colorado School of Mines, representing the Rocky Mountain Section, finished third.

STUDENT POSTER WINNERS:

1st – Bryan McDowell	Colorado School of Mines
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4th – Carlos Sanchez	University of Houston

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Providing the World With More Than Energy

By HEATHER SAUCIER, EXPLORER Correspondent

It's not hard to find a member of the public with a negative opinion about the oil and gas industry. Criticized for being money hungry, destructive to the environment and indifferent toward the communities where they drill, industry leaders have acknowledged they must balance the lopsided equation of public opinion.

Committed to going the extra mile to improve lives and communicate to an often skeptical public, Houston-based Noble Energy has experienced an outpouring of gratitude from the communities in which they operate.

Its successes were highlighted at AAPG's Annual Convention and Exhibition in Houston.

In a presentation called, "Exploration and the Oil and Gas Industry: Having a Positive Impact on People and the World," AAPG member Susan M. Cunningham, senior vice president of the Gulf of Mexico, West Africa and Frontier region at Noble, showed that by slowing down, a company can actually gain momentum.

Noble is a leading independent energy and S&P 500 company with a broad asset base that includes development and exploration in Colorado, the deepwater Gulf of Mexico, West Africa, Israel and Cyprus.

The premise underscoring all of Noble's projects is that the opportunity to explore and develop is a privilege and not a right, Cunningham told a sold-out crowd at the George R. Brown Convention Center.


CUNNINGHAM

> "You need a conversation to understand why a person is upset and attempt to see the matter from their perspective."

As such, the company is committed to:

- Providing people with cleaner and more affordable energy.
- Creating and contributing to diverse social programs.
- Boosting local economies.
- Explaining the myths and facts of controversial practices, such as hydraulic fracturing.
- Reducing greenhouse gas emissions.
- Performing simple acts of responsibility, such as closing a property's gates at the end of the day.

"I don't know how many times in my career I have had conversations in which we, as an industry, have said we've done a bad job communicating. And then each individual company goes and does its own thing, and none of us takes that on," Cunningham said.

"But Noble is … doing everything we can," she said, "to ensure that everyone we work with – landowners, the government, employees, stakeholders, the communities we are in, our partners, suppliers, everybody – benefits."

'Bettering People's Lives'

Cunningham, who received an AAPG Distinguished Service award in 2011, focused part of her talk on her company's experience with cause-and-effect in Israel.

Despite industry predictions of high pressure wells, high well costs and a low probability of a discovery in Israel's offshore Tamar Field, Noble and its partners made one of its largest discoveries there in 2009 – as well as seven consecutive discoveries in the Levant Basin.

They now are paving the way for Israel's energy independence and economic prosperity, Cunningham said.

Noble currently dominates Israel's natural gas production and has transformed the country's electricity generation by providing clean, reliable and domestically produced energy for the first time in Israel's history.

Natural gas is now the fuel of choice rather than coal and diesel. The resulting reduction in greenhouse gas emissions can be likened to removing all the cars in Israel from the road for 16 years, she said.

In Equatorial Guinea on Africa's west coast, Noble is leaving behind a social legacy. The only oil and natural gas company to maintain a continuous presence there for more than 20 years, Noble's three producing offshore wells were responsible for 28 percent of the company's total sales volume in 2013, Cunningham said. The company has been able to invest $13 million in area programs to eradicate malaria, staying true to its mission of "energizing the world, bettering people's lives."

To date, the malaria parasite there has been reduced by 75 percent in children younger than 15, she said. The company also is supporting the development of a potential vaccine for the virus.

The Ripple Effect

In Colorado, Noble's commitment

See **Cunningham**, page 54

Editor's note: Reetu Ragini is the Asia-Pacific YP Lead, and Jonathan Allen is the YP Committee vice chair.

PROTRACKS

YPs Opening Doors Across AAPG's Asia-Pacific Region

By REETU RAGINI and JONATHAN ALLEN

AAPG is an organization driven by highly devoted members who aim to enlighten other geoscientists, both young and experienced, with novel strategies intended to close knowledge gaps and provide perspective in a fast-paced, global environment.

AAPG's organizational structure relies on dedicated volunteers to carry out its mission. One of the many challenges for the Association is to keep our current volunteers engaged and to encourage other members to volunteer their time.


RAGINI


ALLEN

An engaged membership is an absolute necessity for the sustainability and growth of our organization.

To that end, we encourage our young professional cohorts to get involved early and often with AAPG.

Here are a few characteristics of effective volunteers:

- **Be an extrovert**: A social person with a gregarious nature is more influential in conveying their words than a more introverted individual. To bridge the gap between two people, one has to take the initiative – and why shouldn't that be you?

Having trouble approaching people? The YP Meet-n-Greets held every year at ACE and ICE are great opportunities to practice.

- **Be outspoken and share your passion**: Don't be afraid to ask questions or challenge paradigms.

This is our Association, too. Passionate members help inspire others to get involved and continue the success of the organization. In order for AAPG to continue to attract new members, we must address issues such as the value proposition of AAPG for young professionals, the transition from Associate to Active member, funding, sister societies' benefits, etc., as an organization.

Join the conversation and let your voice be heard!

- **Establish personal relationships**: Volunteering for AAPG opens the door to a vast network of geoscience professionals. The opportunities that come from sitting on a committee, becoming involved with the organization of annual meetings or sitting on the HoD can help shape your career.

YPs should understand the importance of being part of a professional organization early in their careers. The Student-YP liaisons and YP committee are examples in which YPs can get involved with AAPG.

- **Grab opportunities**: There are many opportunities to become involved with AAPG. There are a number of committees in need of enthusiastic participants. Explore the existing AAPG committees and identify several that interest you. Email the chairs – or just show up to their annual meetings at ACE – and get involved.

You need to be proactive and grab opportunities rather than wait for them to be handed to you.

- **Engage existing members**: Always take the opportunity to discuss the benefits of volunteering for AAPG with existing members who may not be actively involved in the society.

Only when members are committed to improving AAPG will the organization grow and progress.

- **Recognize others**: AAPG thrives due to its volunteer population. Always remember to communicate your appreciation to your volunteers.

A simple "thank you" lets volunteers know they are appreciated and will go a long way towards making sure they remain active participants in the Association.

* * *

The Asia-Pacific YPs are great examples of the above traits.

When I began the Young Professional activities in the Asia-Pacific Region, I hardly knew anyone in this organization and was unfamiliar with many of the roles and responsibilities that come with a leadership position in the organization. My main objective was to bridge the gap between the YPs in different geographic locations.

Though I initially faced many roadblocks in convincing people that establishing the YPs in the Asia-Pacific Region was a worthwhile endeavor, my determination to grow and flourish AAPG in the eastern part of the world has resulted in many accomplishments. For example:

- We now have active YP Chapters in Indonesia, India, Kuala Lumpur and Pakistan.
- We have field trips, Visiting Geoscientist programs and guest lectures.
- We have YP talks and YP participation in events such as ICE, PGCE and ATC.

It's all growing like the flame of a just lit candle.

Ready to join the effort?

I wish to recruit more volunteers in Australia, China and Thailand in the next several months in order to grow AAPG as a truly global organization.

INMEMORY

Carl Council Ferguson, 77
La Vergne, Tenn., March 4, 2014
Vincent Jon Hamilton, 50
Carouge, Switzerland
March 10, 2014
Merlin A. Johnson, 88
Okemos, Mich., Feb. 25, 2014
Crandall Davis Jones, 93
Flagstaff, Ariz., March 22, 2014
Marion K. Jones, 80
Billings, Mont., Nov. 17, 2013
William Henry Kanes, 79
Columbia, S.C., March 4, 2014
Peter Arnold Rona, 79
New Brunswick, N.J., Feb. 20, 2014
Sarah Johanna Stoll, 71
Sheboygan, Wis., Sept. 13, 2013
Andrew Yelenosky, 86
Austin, Texas, Feb. 13, 2014

(Editor's note: "In Memory" listings are based on information received from the AAPG membership department.)

MVSP Enters Public Phase

BY VERN STEFANIC, EXPLORER Managing Editor

The AAPG Foundation's Military Veteran's Scholarship Program has now entered the public phase, which means the membership at large now has the opportunity to contribute to the Foundation's newest program.

Foundation chair James Gibbs made the announcement during the All-Convention Luncheon at the AAPG Annual Convention and Exhibition in Houston.

"I get to tell all of you about a relatively new AAPG Foundation initiative that I'm sure you will find to be of vital importance," Gibbs told the large gathering. "I'm talking about the Military Veterans Scholarship Program, which was created during the past year to promote and support educational advancement and career opportunities in geosciences to the U.S. veteran population.

"For the past several months we started and slowly built this program through private and personal solicitations," Gibbs continued. "And through this approach some wonderful people provided some very generous funds to help us get things started.

But now, Gibbs said, the "program is ready to enter the important public phase of development – and this means all of us now have a chance to provide the opportunity for brave men and women veterans to continue to provide service by being part of the world of geosciences."

The MVSP was announced in late 2013, started with an initial donation by Shell and boosted through a $50,000 gift from John F. Bookout Jr. A recent sizable gift to the fund also was made by AAPG Honorary member and Foundation Trustee Paul Strunk.

AAPG Foundation Chair James Gibbs at the ACE All-Convention Luncheon.

The fund's goal, Gibbs said, "is to help support these highly trained and talented men and women as they pursue degrees that will enable them to gain employment within the oil and gas industry.

"By contributing to the fund, you have the direct opportunity to have a lasting impact on veterans who share your passion for the geosciences," Gibbs said.

For more information visit the Foundation site at foundation.aapg.org.

Cunningham
from page 52

to bettering communities and the environment has created ripple effects throughout the state, where the company is currently operating in the DJ Basin. Noble executives proactively meet with local communities to quell any anxieties they might have, Cunningham said.

"It's the first impression of the industry," she explained. "It's a privilege that they allow us to drill, and therefore we owe it to them to be respectful by meeting with them and leaving the place better than it was before.

"You've got to really listen to people because they are afraid of the unknown, and that means us," Cunningham continued. "You can't just tell people they're wrong. You need a conversation to understand why a person is upset and attempt to see the matter from their perspective."

Initially reluctant to shoot 3-D seismic in Colorado because of the technology's high costs, Cunningham said now the company "can't live without it." While 2-D seismic can reveal large structural traps, 3-D seismic can often pinpoint complex formations and stratigraphic plays, improving the odds of a discovery and reducing the number of exploration wells.

"It's more than paid for itself," she said, explaining that the average cost of seismic per well is approximately $4,000, which is less than 0.1 percent of the cost of a typical well.

In Colorado, Noble recently worked with the Environmental Defense Fund, Anadarko Petroleum Corporation and EnCana Corporation to develop language for some of the most stringent air rules regulating hydrocarbon emissions in the country.

"We want to keep methane in the pipe and out of the air," Cunningham said. "We don't look at regulators as the enemy but as trying to make the world a better place."

By moving to centralized facilities, tankless operations and oil and water gathering systems, Noble has removed 224,000 truck trips from Colorado roads, eliminating 626,000 tons of CO_2 emissions (equivalent to 118,000 passenger vehicles) and 200 million road miles.

In 2012, the oil and natural gas industry generated $30 billion for the Colorado economy, which equates to $81 million a day, Cunningham said.

"That's more than 110,000 jobs and $1.6 billion in tax revenue for important things like schools, parks and roads," she said. Furthermore, oil and natural gas production in Colorado also contributes to making household energy costs 23 percent lower than the national average.

"For us to be sustainable and grow at the rate we intend to, we have to take a long-term view and slow down to understand things," she said. "It's all about being purposeful in everything we do. It's recognizing that every human being wants to make a positive difference in the world.

"We believe we can have the energy we need," she said, "and the economy we want."

The monthly list of AAPG Foundation contributions is based on information provided by the AAPG Foundation office.

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A little bit Kirk, a little bit Spock

Courage, Calculation Both Needed for Success

By BRIAN ERVIN, EXPLORER Assistant Managing Editor

To be an innovator in the never-ending search for new oil and gas resources, a good geologist needs to escape the stagnating perils of paradigm paralysis by being equal parts Captain Kirk and Mr. Spock.

That was the message of Carlos Dengo as he delivered the Michel T. Halbouty Lecture at the Annual Convention and Exhibition in Houston last month.


DENGO

> **"Time will show that what we accept today as the paradigms in our industry will one day be proven wrong."**

Dengo is a former executive with Exxon Mobil, current principle of Tierranos Consulting and director of the Berg-Hughes Center for Petroleum and Sedimentary Systems at Texas A&M University. He is also a recipient of AAPG's Wallace E. Pratt Memorial Award, among other industry awards, and has served as an AAPG International Distinguished Lecturer and on the AAPG Advisory Council.

In his talk on "Transcending Geoscience Paradigms for Exploration Opportunity Growth," Dengo referenced the leaders of the original Enterprise crew to illustrate the ideal balance between scientific discipline and original thinking.

"Preparing this talk was an opportunity to reflect on what I believe to be my experience in my career, which is the role of human creativity and technology as success factors in our industry," he told the large crowd in Houston.

"I can think of no better example of our challenges in the industry than recalling the 'Star Trek' series … The success of the Starship Enterprise's mission of boldly going where no one has gone before – as does our industry – depended on the creative, risk-taking Captain Kirk … but he could not have ever been successful had that not been balanced by the sound application of logic, data and information analysis and technology provided by Mr. Spock.

"Both are necessary for success," Dengo continued.

Long-held paradigms of geology and geophysics are known to change, he said, yet it is easy to become blind to "non-nail problems" when a hammer comes to be relied upon as the only tool.

"Where oil is first found, in the final analysis, is in the minds of men," Dengo said, quoting AAPG legend Wallace Pratt, and followed up with another oft-cited Prattism: "Mental inflexibility is the greatest hurdle to overcome in finding oil."

Here Today, Wrong Tomorrow

He highlighted a series of paradigm shifts that have occurred within the industry that seem obvious in hindsight, but were iconoclastic for their time, like the development of a unifying framework to understand the basic correlation offered by the concepts of plate tectonics, and the development of deepwater exploration plays.

"There were very heated debates over whether you could even have reservoir rocks deposited in deep water," Dengo noted.

He also noted, "the realization that rocks with nanoporosities – once thought to be only source or seals – are actually producing reservoirs."

Also, of course, there have been game-changing technologies: "Rotary and horizontal extended reach drilling; deepwater drilling that exceeds depths of 10,000 feet, vast improvements in seismic, going from 2-D migrated lines to today with what is probably the Holy Grail of imaging – full wavefield inversion. Improvements in reservoir modeling and simulation, and many others that aren't listed here," he elaborated.

"And no talk would be complete without mention of unconventional resources, which on their own offer some unique lessons," Dengo also said. "There is no better example than that of the unconventional shale gas and oil resources, which is transforming the energy outlooks, not only of North American, but globally – literally as we meet here today."

"Time will show that what we accept today as the paradigms in our industry will

Continued on next page

Scott Tinker talking about shale proved to be a big draw for the EMD in Houston.

Shale
from page 58

A relatively new concern is the now-unusual flaring of natural gas in oil/liquids-rich plays, particularly the Bakken in North Dakota and the Eagle Ford in Texas.

"Flaring gas – didn't we quit doing that last century?" Tinker asked. "It's coming at us like a train, and we need to figure out what to do with this gas.

"It's energy, it's methane emissions, it's CO_2," he noted. "We can fix this; there are a lot of options for using this gas."

There's a substantial amount of work awaiting, judging from Tinker's to-do list.

Much of it is environmental-related.

Environmental implications include:

- Traffic/noise/light.
- Land.
- Earthquakes.
- Water.
- NORM.
- Methane and carbon.

He noted that security issues come into play as well – and the two aren't mutually exclusive.

Regulatory considerations include:

- Mandatory baseline data.
- Cement all gas producing zones.
- Minimize fresh water use on the front end.
- Full disclosure of chemicals.
- Handle flowback and produced water (treat and reuse; dispose – characterize for faults).
- Minimize methane emissions.
- Minimize surface impact.
- Horizontals minimize the number of well pads.

A Different Conversation?

Amidst all the frequent hubbub of shale-angst emanating from a number of sources is an unspoken, yet profound, basic fact in the overall energy picture.

"Most people don't know how electricity or gas are made," Tinker noted. "And they likely don't care.

"The public is free not to like everything, but this means we must take the energy conversation to a different place," he said.

"The conversation we need to have is about the things that energy provides to the world," he emphasized.

Speaking about the world, a question arose from a luncheon attendee: "Do shales stop at the modern coastlines?"

If you get a handle on how to economically drill and develop shale plays offshore, say goodbye to any financial worries you might have.

Continued from previous page

one day be proven wrong," Dengo added.

That, he said, is why geologists should strive for the aforementioned qualities exemplified by Kirk and Spock.

"But, Kirk and Spock retired, and now we face a wave of retirements in our industry and a great loss of that knowledge and experience," Dengo concluded. "Independent oil companies and national oil companies will all seek to explore and produce hydrocarbon resources, and each will have a different advantage and/or disadvantage, in terms of their resource access, their technology, data and financial resources.

"But at the center of industry success," he said, "will be, of course, the human capital and the need to explore new questions through a focus on the fundamentals of our science with data, information, and the ability for the new generations to develop their own experience and knowledge, and hopefully some wisdom."

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DIRECTOR'S CORNER

AAPG Ready for Its Role at the Upcoming OTC

By DAVID CURTISS

Houston – the largest city in Texas and fourth-largest city in the United States – is widely considered the oil capital of the world. If you're employed in our industry, the odds are high that you have either lived in Houston or frequently visit.

Many AAPG members were in town last month for a tremendously successful 2014 Annual Convention and Exhibition. Our thanks as an Association go out to the Organizing Committee and AAPG staff who worked so hard to design the technical program and other convention events, providing each of the attendees with a chance to learn and network, both essential to doing their jobs better.

This month the city of Houston will welcome back its largest annual convention, the Offshore Technology Conference (OTC), which begins May 5.

Back in 1969, 12 scientific and professional societies and associations came together to create an event focused on all aspects of energy production offshore. The range and scope of the participating organizations is far-reaching:

- American Association of Petroleum Geologists
- American Institute of Chemical Engineers
- American Institute of Mining, Metallurgical, and Petroleum Engineers
- American Society of Civil Engineers
- ASME International Petroleum Technology Institute
- Institute of Electrical and Electronics Engineers, Oceanic and Engineering Society
- Marine Technology Society
- Society of Exploration Geophysicists


CURTISS

> This is the place to bring people to get a sense of the size and scale of the oil and natural gas industry – it just goes on and on.

- Society for Mining, Metallurgy and Exploration
- Society of Naval Architects and Marine Engineers
- Society of Petroleum Engineers
- The Minerals, Metals and Materials Society

In addition, there are additional endorsing and supporting organizations for OTC.

Oversight for OTC is provided by a board of directors representing the sponsoring organizations – each of the organizations has a representative, and **Cindy Yeilding**, vice president-Gulf of Mexico exploration for BP, currently serves in this capacity for AAPG.

OTC is a big show. Since 1969 more than 2.2 million attendees have participated. Last year alone attendance reached 101,000, once again approaching the 1982 high of 108,000. And the city of Houston has derived over $2.5 billion in economic value during the history of the event.

The draw for these attendees: a robust and peer-developed technical program and an exhibition of state-of-the-art technology and services needed in offshore energy production.

In fact, a walk through the OTC exhibition can be pretty overwhelming. Last year it encompassed more than 652,000 net square feet of exhibition space and included more than 2,700 exhibiting companies.

This is the place to bring people to get a sense of the size and scale of the oil and natural gas industry – it just goes on and on.

* * *

The technical program this year includes a host of AAPG-sponsored sessions, ranging from an ethics breakfast on Monday, May 5, where Silvia Peppoloni will speak about "Geoethics: A Way of Thinking and Practicing Geosciences."

Other sessions include geohazard assessments, emerging offshore geoscience technologies, methane hydrates and the Law of the Sea. And this is just a sampling of the 15 sessions or events that AAPG is sponsoring.

We owe a debt of gratitude to the AAPG program committee who worked with their counterparts from the other sponsoring organizations to design and deliver this technical program.

- Buford Pollett, chair, Eni
- Eric Cauquil, vice chair, Total
- Michael Abrams, Apache Corp.
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- Randall Cooper, Marathon Oil
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- Nina Rach, E&P Magazine
- R.C. Shipp, Shell International E&P
- James Thomson, BP plc
- Stephen Wardlawm, Fugro GeoConsulting Inc.

OTC board members Cindy Yeilding and Wafik Beydoun, representing the Society of Exploration Geophysicists, have declared Tuesday, May 6 to be "Geosciences Day" at OTC, and there will be a reception for all AAPG and SEG members and other geoscientists attending OTC.

* * *

There's a lot to do and see at OTC – you owe it to yourself to come and see what the buzz is all about.

Be sure to stop by the AAPG booth and say hi!

DIVISIONS REPORT: EMD

Shale: An Evolution, Not a Revolution

By LOUISE S. DURHAM, EXPLORER Correspondent

When you need in-depth, science-based information on shale plays and issues, AAPG past president Scott Tinker has the reputation as the go-to guy.

He played that role again at the recent AAPG Annual Convention and Exhibition in Houston.

Tinker was a high profile presence at the ACE in Houston, where he chaired a forum focused in large part on hydraulic fracturing and was the featured speaker at the EMD luncheon talking about, of course, shale.

For starters he emphasized that the relatively new shale phenomenon is not a revolution as it's usually tagged.

"It's an evolution, although pretty quick," he said. "The technology, demand, creativity, risk – the things we've always had in this business – drove this evolution."

Attesting to its impact, Tinker noted humorously: "In the 1980s, if you cored a shale, you got fired; in 2010 if you didn't core a shale, you got fired."

Tinker is the Texas state geologist and also professor, Edwin Allday endowed chair in subsurface geology, at the Jackson School of geosciences, University of Texas at Austin.

He's also a movie star of sorts, having appeared in theatrically released energy related films. The latest is the award-winning "Switch," which he conceived and guided through the production process.

Scott Tinker, speaking at the EMD luncheon in Houston.

It's widely known that the legendary George Mitchell and his company team spent 17 years doggedly pursuing the needed technology to economically produce the now-famous Barnett Shale. Their ultimate success is widely recognized as the harbinger of the current "shale boom."

The Barnett, along with the Haynesville, Fayetteville and Marcellus shale plays are included in a four-basin study of shale gas reserves funded by the Alfred P. Sloan foundation and conducted by the Bureau of Economic Geology on Tinker's turf at the University of Texas at Austin.

The study showed that the Barnett itself is an enormous resource with huge potential, even at somewhat low prices.

In the base case using $4 gas, the assessment forecasts a cumulative 44 TCF of recoverable reserves from the Barnett through 2050 based on already-drilled wells and wells to be drilled through 2030.

The Fayetteville assessment, which followed the same methodology as the Barnett, integrating engineering, geology and economics, estimated technically recoverable gas reserves of 38 TCF for the region. Eighteen TCF reportedly will be economically feasible to recover at $4/mcf.

"There's a lot of natural gas in the world, a lot of shale gas and tight gas here," Tinker noted. "As a result of this shale evolution, the price of gas in the United States is about $4, but in the rest of the world it's $10, $12, $16."

Implications and Considerations

Tinker pondered aloud during his luncheon talk as to how long this still-evolving action will last.

After all, there is plenty of anger in some corners of the United States, and elsewhere around the world, about a number of issues associated with shale drilling. Hydraulic fracturing no doubt is the largest of the perceived threats in the public domain.

See **Shale**, page 57

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